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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

The Foundry Trades' Equipment and Supplies Association

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Scrap Salvage

Last week some 5,000 tons of cast-iron railings were received by the scrap merchants, and few will regret the fact of their passing. Some, however, are of historic value, such as those enclosing St. Paul's Churchyard, which were cast in Sussex in the 16th century. Sentiment will demand the replacement of this type of antique casting, and foundrymen can help by letting it be known that, if only the scrap merchants will retain one good specimen, it can, after shot blasting, be used as a pattern for post-war replacements. Let it be known that, if only this precaution be taken, the modern foundry could so well imitate the antique that it would give the metallurgist of 2042 a headache to differentiate between the old and relatively new.

If the Ministry of Supply make raids on lamp standards, it should ascertain before starting its depredations on the more artistic variety, such as are installed on the Embankment, whether the patterns exist; failing this, to leave a good specimen available as a pattern. This obviously sounds elementary to the foundryman, but that is not the point. It happens to be information which is not appreciated by laymen, and it is up to the foundryman to make propaganda for the preservation of his *chef d'œuvres* and antiques without materially affecting the national scrap campaign.

It is with a good deal of satisfaction that we learn that each district is inviting any local expert to advise the local authority on any difficulty that may arise with scrap sorting, for it presents an excellent opportunity for the conservation of valuable specimens of the founder's art, and we strongly advise those of our readers —and there are many—who have an interest in the history of foundry practice to offer their services in a consulting capacity. This specially refers to those who have retired from the industry and are living in the more rural areas which are quite likely to yield interesting specimens of antique firebricks, spits, fire dogs, kitchen grinding mills, and the like.

It can be reasonably expected that in the near future there will be a drive for the salvage of brass and bronze, and here, indeed, is the need for careful discrimination between the worthwhile and the spurious. Much that is esteemed by the incognoscenti as being of oriental origin is in reality the product of the Birmingham foundries, and is of little value. The present position, if handled intelligently, can reinforce the national wealth in artistic and antique castings, whilst at the same time augmenting the scrap pile and ridding the country of much inartistic and useless trash.

The 1940-41 Proceedings

Because of its new format, the 1940-41 Volume of the Proceedings of the Institute of British Foundrymen may seem to be somewhat attenuated if compared with the 1938-39 transactions, which included the International Conference. However, if it were reduced to the smaller format which carried the Institute's Proceedings for over twenty years, then it would be expanded into a volume of over 500 pages. Thus, so far as the volume is concerned, the normal pre-war standard has been maintained. The next criterion by which such works is judged is variety of the contents, as this gives an indication as to whether the field has been adequately covered. An analysis shows that nine Papers are devoted to cast iron; five to non-ferrous metals; one each to malleable steel and vitreous enamelling, and five to matters of general interest—these being mainly devoted to questions of sand. The most obvious omission is the subject of die casting. There is a recurrent unsubstantiated wail that too large a part of the Institute's work is of a theoretical or metallurgical character. On a conservative basis 50 per cent. of the matter contained in this volume is of a definitely practical character, and well capable to being understood and assimilated by any intelligent skilled craftsman. Congratulations are due to the South African Branch and the East Anglian Section of the London Branch as having each supplied four Papers, and so head the list. These two comparatively recently formed groups have enriched the literature of foundry practice in no inconsiderable measure. Moreover, there is every promise that the high standard reached will be maintained. The indexing, the value of which increases with the accumulation of knowledge and the passage of time, is particularly well done. It is to be hoped that the issue to members of this volume will stimulate the dormant branches into renewed activity, for surely the urge for enriching foundry technology must be in existence equally throughout the country. It merely needs awakening by a handful of enthusiasts.

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Institute of British Foundrymen

NEW MEMBERS

At a meeting of the Council of the Institute of British Foundrymen, held at the Midland Hotel, Derby, on January 17, the following were elected to the various grades of membership.

Members

F. Allen, chief chemist and metallurgist, Magnal Products, Limited; W. E. Bell, metallurgist, A. Cohen & Company; A. L. Bradley, chemist, Streetley Lime & Basic Company; T. W. Duthie, sand supplier, Alex. Murdoch; R. Henderson, assistant works manager, Millery Company, Limited; L. J. King, managing director, Glow-Worm Boilers, Limited; A. E. Liddemore, late of Palestine; W. M. Lord, director, Sandholme Iron Company, Limited; C. H. Mercer, engineer, Field Foundry; J. Morgan, metallurgist, Magnal Products, Limited; T. E. Rowlands, foundry and works manager, Cwmbran Engineering Company, Limited; S. A. Shingler, mechanical and marine engineer; E. R. Wellburn, metallurgist, Plessey Company; H. Buckley, foreman patternmaker, T. Ashworth & Company; N. Clark, technical director, Astbury Silica Company; W. Fearnside, foundry director, Albert Foundry, Keighley; S. A. Horton, chief inspector, Leys Malleable Castings Company, Limited; W. A. Curran, foundry manager, Cardiff Foundry & Engineering Company; L. G. Hemsley, chemist, Dartmouth Auto Castings; J. I. Hughes, proprietor, Loughor Foundry; J. Tinkler, draughtsman, Vauxhall Motors; O. J. G. Wootton, director, O. J. Wootton, Limited.

Associate Members

G. S. Britton, patternmaker, Bristol Aeroplane Company, Limited; E. B. Brown, chemist, Stanton Ironworks Company, Limited; G. H. Fern, foundry foreman, Wm. Knott & Son; J. Gartside, moulder, D. Bridge & Company; D. C. Gaze, sample passer, Brown, Lenox & Company; A. Gregory, sample passer, Brown, Lenox & Company; J. W. Hardman, coremaker, Metropolitan-Vickers Electric Company; W. H. Forrest, iron moulder, Dawson Payne & Elliott; R. I. Hoon, patternmaker, Ley's Malleable Castings Company, Limited; R. Parish, production engineer, English Electric Company, Limited; W. Peacock, coremaker, Airedale Light Alloys, Limited; W. Tomlinson, chargehand, Ley's Malleable Castings Company, Limited; L. J. Wilde, metal patternmaker, Ley's Malleable Castings Company, Limited; B. Malone, foreman moulder, Dartmouth Auto Castings, Limited; J. Greatorex, moulder, Brown, Lenox & Company, Limited; C. W. Anderson, general moulder, Crossley Premier Engines, Limited; E. A. Ankers, general moulder, Crossley Premier Engines, Limited; F. V. Brightwell, engineer patternmaker; J. Buchanan, draughtsman, Coltness Iron Company, Limited; F. J. Bullock, assistant engineer; J. B. Caldwell, metallurgical chemist, Coltness Iron Company, Limited; L. Clegg, moulder, Hopkinsons, Huddersfield; F. Coupe, patternmaker, Wm. Coupe & Sons; J. Coupe, moulder, Wm. Coupe & Sons; W. Coupe, Junr., foreman moulder, Wm. Coupe & Sons; C. H. Crompton, moulder, East Rand Engineering Company, Limited; C. W. Fenton, foreman patternmaker, Eclipse Tube Mill Liner; F. Gater, assistant foundry manager, Hargreaves & Jennings, Limited; H. G. Goyns, planner and engineer, D. Brown & Sons, Penistone; W. M. Harris, moulder, Taylor & Wilson; H. S. Hart, moulder, Drake, Limited, Halifax; R. A. Howard, analytical chemist, E. Hind, Limited; R. Iddon, patternmaker, Iddon Bros., Limited, Leyland; A. R. Kinna, foreman, J. G. Statter & Company, Limited; S. I. Langenegger, patternmaker, East Rand Engineering Company, Limited; L. Lester, foreman moulder, Beeston Boiler Company, Limited; G. Mann, metallurgist, Royal Aircraft Establishment; J. W. Mobbs, patternmaker, Modern Foundries, Limited, Halifax; J. Paine, foreman, Field Foundry; C. B. Scarcliffe, foreman moulder, D. Owen & Sons, Monton; T. H. Sneddon, junior draughtsman, Clyde Alloy Steel Company, Limited; F. Spray, moulder, Beeston Boiler Company, Limited; D. G. Thomas, draughtsman, Bristol Aeroplane Company, Limited; W. A. Robotham, coremaker, Brown, Lenox & Company; G. Collins, foundry superintendent, Cardiff Foundry & Engineering Company, Limited; G. H. Conroy, steel foundry manager, Gabriel & Company, Limited; E. Curran, draughtsman, Cardiff Foundry & Engineering Company, Limited; S. Domville, steel foundry superintendent, Cardiff Foundry & Engineering Company, Limited; J. R. Horton, assistant metallurgical chemist, Worthington Simpson, Limited; L. M. McDonald, plant engineer, Ley's Malleable Castings Company, Limited.

Associates

J. S. Came, apprentice patternmaker, Bristol Aeroplane Company, Limited; E. W. Popplestone, assistant foundry technician, Airedale Light Alloys, Limited.

Moonlight Calendars

Mr. Barrington Hooper, C.B.E., managing director of THE FOUNDRY TRADE JOURNAL, *has again prepared a moonlight calendar for 1942. He has a limited number available for any reader sending him a stamped-addressed envelope. These calendars are particularly popular with fire watchers, and those responsible for the fixing of periodic meetings.*

Associates (*Students*)

V. S. James, student moulder, Brown, Lenox; G. T. Kinglake, student moulder, Brown, Lenox; J. H. Morgan, student moulder, Brown, Lenox; S. G. Richards, apprentice; J. D. Dawson, apprentice patternmaker, Ashmore, Benson, Pease & Company; J. Ladhams, moulder, Head Wrightson, Limited; T. S. Mallaby, apprentice patternmaker, Ashmore, Benson, Pease & Company, Limited; I. D. Milne, apprentice patternmaker, Ashmore, Benson, Pease & Company, Limited; B. N. Milroy, iron moulder, Pease & Partners; A. L. Morgan, apprentice patternmaker, Pease & Partners.

"Ebonol" Blackening Process

An immersion process called Ebonol Z for blackening of zinc, stainless steel, steel and other alloys is announced by Enthone Company, New Haven, Conn. It consists of immersing the metal in a 1-lb.-per-gall. solution of Ebonol Z salts (in 1 gall. of water) at a temperature from 150 to 212 deg. F., forming a jet black finish on the metal in 1 to 5 min. According to the manufacturer, 1 lb. of salts will blacken over 150 sq. ft. of zinc surface. The solution can be used for producing a black coating on stainless steel, nickel silver, nickel and noble metals by making a couple with these metals and a piece of zinc. Unlike plated or enamelled coatings, the Ebonol Z coating does not change the thickness of the piece more than a few hundred thousandths of an inch, thus maintaining close dimensions. Also, the bath is not critical and requires little control.

THE TOTAL NUMBER of defence industrial projects approved in the United States from June, 1940, to end of September, 1941, was 3,004, with a total estimated cost of $5,260,463,000.

Random Shots

The showing of a number of lantern slides followed by a unique coloured film, at the last meeting of the London Branch of the Institute of British Foundrymen, proved to be a tremendous success. Much of that success, as the lecturer, Mr. Currie, pointed out, was due to the expertness of the operator, on that occasion Mr. Barrington Hooper. Lecturers who illustrate their points with lantern slides too often suffer from the failure of a slide to appear on the screen altogether, or at least to appear upside down. Not so on this occasion; everything went smoothly, but few of the audience were aware of the frantic rush beforehand which had been necessary to achieve that success. At 12.50, when a broken bulb was discovered, both lecturer and operator dashed in a taxi to Mr. Currie's office in Victoria Street to replace it. Here they had no luck, but just as they were coming away disconsolately, they espied a wireless shop on the other side of the road. Dashing in just as the shutters were being put up for the week-end, they procured the last one the man had in stock (and he had very little prospect of ever replacing his stock either). Altogether, the lantern of the London Branch has led a charmed life. Originally given by an anonymous donor, whose identity time has failed to reveal, it passed a calm enough existence until last winter, during which trying period it was first bombed out at Charing Cross Hotel, and later at the National Liberal Club. On neither occasion did it suffer any damage whatsoever.

* * *

Many of the reasons given for absenteeism would be amusing if they were not so exasperating, or of such serious consequences. One moulder recently lost a whole day's pay and had to take a return tram fare on a longish journey in order to have a tooth taken out at the infirmary. When it was pointed out that there was a dentist on the premises, he replied: "Ney, at t' infirmary, they tek it owt for nowt!" In former times when staying away from work was not such a serious matter, one could have felt a glimmer of sympathy for the man, to whom the glamour of "owt for nowt" was so irresistible; for "Marksman" himself can remember once taking a bus all the way from the West End to North Woolwich merely for the pleasure of crossing the Thames by the Woolwich free ferry. Though in defence of such foolish behaviour it must be admitted that there was the attraction of the Painted Hall at Greenwich on the other side, a visit to which could (and was) included on the return journey.

* * *

The latest incentive to the collection of scrap is to organise dances, the admission to which is the donation of "any old iron." This idea, though excellent in some districts, is not likely to be of real practical value in a foundry community, for the temptation to visit the firm's scrap heap the night before would prove too great. On the other hand, if it would induce the apprentices to exhume the bodies of their past failures from their private cemeteries, much scrap might be brought forth which might otherwise lie fallow for many years.

* * *

Inquiries have been pouring in from harassed foundry managers asking whether a "core-maker minder" is a new type of reserved occupation. "Marksman" hastens to correct the impression that a core-maker needs a minder, though the printers seem to think so.

* * *

The best crossword clue of the week comes from the "Sunday Times":

Clue: Hardly describes pictures of bathing belles.

Answer: Underexposed.

"MARKSMAN."

Physical Conditions in the Blast Furnace During Smelting*

DESCRIPTION AND ANALYSIS OF EXPERIMENTAL WORK

In addition to the purely chemical and physico-chemical reactions which occur in the blast furnace, there are a variety of physical conditions which in their turn also have a decisive bearing on the efficiency and general progress of the smelting process. These conditions are examined by F. HARTMANN in Report No. 195 of the Blast Furnace Sub-committee of the Verein deutscher Eisenhüttenleute, published in "Stahl und Eisen," from the point of view of physical changes which the various components of the charge undergo on their passage from the charging platform to their removal from the furnace at the tap hole. The sequence of physical changes which occur may be classified under the following heads:

(1) On first heating, certain changes occur

TABLE I.—*Chemical Analyses of Ores Investigated.*

Ore.	FeO	CaO	MgO	Al_2O_3 and TiO_2	SiO_2	CaO : SiO_2
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Swedish	60·50	2·19	1·49	2·55	4·85	0·45
Minette	31·50	16·07	1·10	4·57	6·14	2·6
Freiburg	21·68	21·63	1·01	7·35	16·30	1·3

in portions of the solid charge, particularly in lumps of ore of heterogeneous composition, which the author describes as "diffusion."

(2) On further heating to between 500 and 700 deg., the ore lumps commence to disintegrate owing to the deposition of carbon by the interaction of carbon monoxide and iron oxide. According to investigations by Baukloh and his collaborators part of the ore now breaks up into pea size. This process is incomplete, probably owing to the short time available, and even at levels 11 m. below the top of the charge "sooty" and still well-preserved ore lumps may subsist. Disintegration may be retarded by the presence of arsenious vapours in the blast-furnace gases, for arsenic inhibits the reaction; this effect has been demonstrated in unpublished work carried out by the research department of the Vereinigte Stahlwerke.

(3) When a certain critical temperature is

TABLE II.—*Fritting and Sintering of Ores.* (*In Deg. C.*).

Ore.	Atmos.	Still loose.	Fritting.		Sintering.	
			Light baked.	Well baked.	Lightly sintered.	Fully molten.
Swedish	Neutral	1,000	—	—	1,100	—
	Reducing	1,000	—	—	1,100	—
Minette	Neutral	1,000	—	—	1,100	
	Reducing	900	—	1,000	1,100	—
Freiburg	Neutral	700	800	1,000	1,100	—
	Reducing	700	800	1,000	1,050	1,100

exceeded, the ore particles start to lose their shape, the sharp edges are rounded off, and the lumps commence to stick together to form larger agglomerates. These changes are restricted to the surface; the cores of the ore lumps remain as yet unaffected.

(4) After carbon dioxide and combined water have been expelled, but frequently without these changes occurring at all, the ore lumps start to contract or to expand. These changes also frequently cause a breaking up of the larger lumps. After passing through this temperature range, the bulk of the charge has been reduced to much smaller entities.

(5) As the temperature further increases the individual ore lumps become entirely plastic, and under the superincumbent pressure are progressively deformed.

(6) Finally the ore lumps become quite plastic; they soften, lose their shape, and agglomerate still further. These aggregates are continually broken up by the grinding and working of the charge.

(7) When the melting point is exceeded, the rigidity of the solid phase is finally destroyed, the particles gradually melt, and a fluid is formed. Several measurements of the viscosity of the liquid phase now formed have been published.

(8) Some of the components are raised to their boiling point, at which either part or the

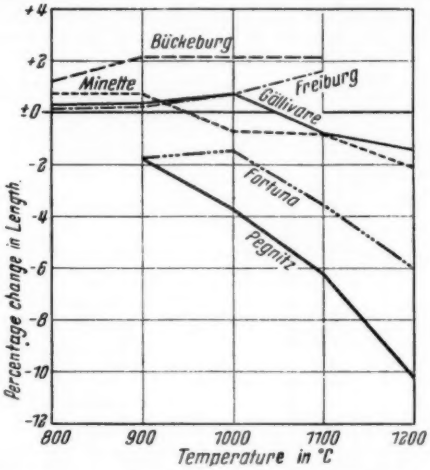


FIG. 1.—EXPANSION AND CONTRACTION OF ORE BRIQUETTES.

whole of them is volatilised. This occurs with alkalis, zinc, zinc oxide, zinc sulphide, lead, lead oxide, arsenious acid, arsenic and sulphur.

Some of the above physical changes have been measured for a charge composed of

TABLE III.—*Deformation of Ores Under Load.*

Ore.	Load in kg. per sq. cm.	Incipient fusion deg. C.	Complete fusion deg. C.
Swedish	0·5	1,220	1,270
	2·0	1,135	1,180
Minette	0·5	900	1,200
	2·0	870	1,150
Freiburg	0·5	1,100	1,200
	2·0	1,090	1,180

Swedish ore, minette, a German ore from the Freiburg region, open-hearth slag, lime, mill scale, scrap, together with the requisite amount of coke. The three ores were selected on the basis of the marked divergence in their general characteristics; the Swedish (Gällivare) ore contained a large proportion of coarse, dense magnetite grains, and was comparatively porous; the minette was very dense and fine in grain, while the Freiburg ore was friable. The chemical analyses of the three ores are given in Table I.

Diffusion and Sintering

No measurements were made of diffusion conditions in the solid phase; although phenomena of this type may take place in the blast furnace, the time they occupy during the descent of the burden would appear to be too short for them to have any far-reaching practical effect.

Results of experiments on the sintering of the ores are given in Table II. In these tests samples of about 200 grms. each were heated in a rotary furnace for periods of 2 hrs. at temperatures of 800, 900, 1,000 and 1,100 deg. C., the material thus being in constant motion throughout heating as in the blast furnace. The atmosphere in the furnace was either made neutral by a slow current of nitrogen, or reducing by passing blast-furnace gas. The Swedish ore remained loose in both atmospheres at 1,000 deg. and sintered at 1,100 deg. The same behaviour was observed with the minette in the neutral atmosphere, but in the reducing atmosphere it sintered already at 1,000 deg. Other details of these experiments may be gathered from Table II.

Expansion and Shrinkage

To determine the growth and shrinkage of the ores, samples were reduced to below 1 mm. and briquettes made measuring 25 by 25 by 80 mm.; these were heated to different temperatures for periods of 2 hrs. and the change in length measured. The results of these measurements are given in Fig. 1, experiments being conducted with three additional ores also. The Swedish ore showed slight expansion between 800 and 1,000 deg., and then commenced to shrink at 1,100 deg.; contraction became more pronounced at 1,200 deg. A similar expansion was observed with the minette at 800 and 900 deg.; shrinkage occurred at 1,000 deg., to become very marked at 1,200 deg. The Freiburg

TABLE IV.—*Melting Points and Viscosities of Ores.*

Ore.	Atmosphere.	Melting point.	Viscosity.	
			150 poise.	5 poise.
Swedish ..	Neutral(N)	1,500	>1,530	Not est.
	Reducing (B.F. gas)	1,395	—	—
Minette ..	Neutral	1,280	1,280	1,340
	Reducing	1,240	—	—
Freiburg ..	Neutral	1,210	1,230	1,250
	Reducing	1,390	—	—

ore showed a progressive expansion at temperatures between 800 and 1,100 deg.

The three extra ores examined showed that a somewhat different behaviour could also be expected at higher temperatures. An ore from Bückeburg expanded similar to the Freiburg up to 1,100 deg., this expansion being, however, more marked. A Fortuna ore, on the other hand, revealed only contraction, as also did a Pegnitz ore which contracted so much that at 1,200 deg. it had shrunk by 10 per cent. of its original size. Similar contraction was shown by other samples of Pegnitz ore (Fig. 2), while with Pegnitz concentrates the contraction was as much as 18 per cent. Central-German ores from various deposits similarly contracted on progressive heating, although the percentage contraction was somewhat less than with the Pegnitz ore.

Other examples are given in Fig. 3. An ore from the Wohlverwahrt mine at Bückeburg expanded on heating; ore from the Klippen deposit slightly expanded and then contracted to resume roughly its original size at 1,200 deg. Other ores showed a contraction. South Baden ores expanded on heating to above 1,000 deg., while Kiruna ore showed no change up to 1,200 deg. Wabana and Swedish ore, the latter again tested as a check, contracted slightly. It is conceivable that the differences between the not inconsiderable size changes of these ores, which were a maximum of 20 per cent., must influence in some way the total volume of the burden and hence affect its descent in the stack.

This expansion and contraction appears to be independent of the external pressure applied

* From Report No. 195 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute by F. Hartmann. Published in "Stahl und Eisen."

Blast Furnace Conditions

to the ore. In the furnace, the ores are, of course, exposed to some pressure. An attempt was therefore made to simulate this pressure at high temperatures by taking lumps of ore, or briquettes in the case of the friable ores, and slowly raising their temperature, while applying a pressure of 0.5 or 2 kg. per sq. cm. These tests were made as prescribed for measuring the refractoriness under load of refractories in the German DIN 1064 standard. Measurements were made of the softening point and complete collapse or fusion of the ore mass. As shown in Table III, the Swedish ore commenced to soften under the lower pressure at 1,220 deg. and fused completely at 1,270 deg. Increasing the load to 2 kg. per sq. cm. lowered both softening values by about 100 deg. Other details are given in Table III, which shows that no change in the temperatures concerned occurred with the Freiburg ore when the load was raised to 2 kg. per sq. cm. It will be noted that an ore behaves very differently at high temperatures according to the load applied. This behaviour is naturally conditioned by the fact that the ore has not undergone any chemical change, especially reduction during the temperature rise.

Fusion Conditions

On a further rise in temperature the ore charge begins to fuse. The melting points of the ores determined according to DIN 1063 in a neutral atmosphere are given in Table IV and are seen to differ widely. The values for a reducing atmosphere are also given, those for the Swedish and minette ores being lower than the melting points in a neutral atmosphere; the opposite was found with the Freiburg ore. The melting points measured represent incipient fusion, for as the temperature is further raised the ore lumps pass through various stages of fluidity. The viscosity was measured by a method evolved in the research laboratory of the Vereinigte Stahlwerke; Table IV thus gives the temperatures at which the ore has an absolute viscosity of 150 poise* and one of 5 poise. The transition to a viscous state in the Swedish ore was too ill-defined to permit of measurements of these temperatures with this ore. The figures for the minette and Freiburg ores are given in the table, and these again show a marked divergence, which as will be shown later has an important influence on conditions in the blast furnace. It should, however, be remembered that at the temperatures concerned the bulk of the ore has already been reduced chemically, although a small portion remains unchanged and is likely to melt under the conditions considered. This is by no means rare with lean ores which sinter and melt at low temperatures, since with these reduction is retarded and inhibited for various reasons.

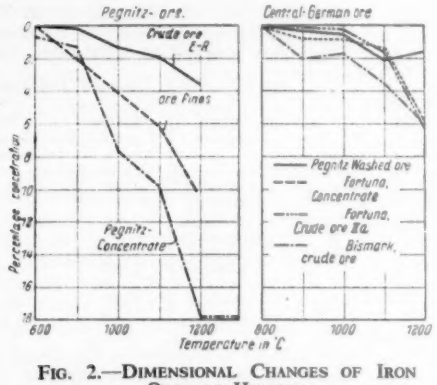


FIG. 2.—DIMENSIONAL CHANGES OF IRON ORES ON HEATING.

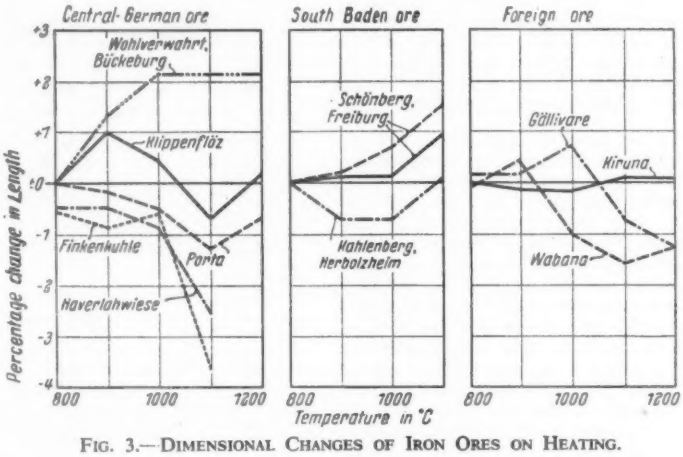


FIG. 3.—DIMENSIONAL CHANGES OF IRON ORES ON HEATING.

Table V.—*Composition of Residual Slags of Ores After Reduction of FeO.*

Ore.	CaO	SiO_2	Al_2O_3 and TiO_2	CaO : SiO_2
	Per cent.	Per cent.	Per cent.	Per cent.
Swedish	20	50	30	0·4
Minette	58	23	17	2·5
Freiburg	57	31	12	1·8

* The poise, the unit of absolute viscosity, is the force in dynes which will move 1 sq. cm. of plane surface with a speed of 1 cm. per sec., relative to another parallel plane surface from which it is separated by a layer of the liquid 1 cm. thick, i.e. 1 dyne-sec. per sq cm. Equivalent to 14.5 10^{-5} lb.-sec. per sq. in.

No measurements were made of the volatilisation of the various components at high temperatures, and the following sketch of the physical changes in a blast-furnace charge during its descent in the stack is based on the general survey given at the outset and the experimental results above.

Again, referring to the effect of diffusion occurring in the colder parts of the furnace, the author indicates that, while without practical effect on the smelting process, it can yet be detected on isolated pieces of ore. If an ore contains parts rich in lime, some iron oxide will migrate into the lime, and *vice versa*, already at moderate temperatures. Disintegration of the ore lumps by the action of CO, while extensive, is only partial, for it is assumed that the iron oxide which acts as a catalyst is poisoned by arsenic. Expulsion of chemically-bound carbon dioxide usually takes place slowly and without any change in shape of the ore lumps. According to a verbal communication, minette has been observed to split open in this phase.

Changes in Shape

Incipient deformation of the ore lumps, *i.e.*, the rounding of the edges and corners, does not affect the smelting process, although subsequent stages of deformation have varying effects. Fritting, the temperature of which has been measured for various ores, causes a slight agglomeration of the particles, especially of those of dust fineness. Onward from the temperature zone at which this occurs, expulsion of the dust from the furnace suffers restraint, while some interference is also experienced to the free passage of the blast. Sintering proper has a more marked effect than this, the ore particles and the dust then becoming firmly cemented together.

While up to this point the ore lumps and particles can easily slide over each other, their motion through this temperature zone becomes sluggish, the coke, coke dust and lime alone preventing the charge from caking into a compact mass. As the temperature rises further, the first signs of fusion are noticed. Viscous melting cloys the charge and retards its descent. On a further temperature rise, zones of fusion are formed and the lumps begin to run. This occurs in different temperature stages with different ores, such that an easily-fusible ore can cause agglomeration between lumps of ore more difficult to fuse. At the same time, the various components of the charge affect each other in different physical ways. Lumps of a rich ore which have been preserved against indirect reduction and reach hotter zones of the furnace require very high temperatures to melt them; ores with a medium Fe value, such as the Freiburg ore, apparently reach fusion at 1,200 deg., enabling them to run easily between the lumps of coke. It should be noted that the melting point of Freiburg ore in a reducing atmosphere is 1,400 deg., so that isolated lumps of this ore are able to reach higher-temperature zones.

Physical Basis of Evaluating Ores

The basis of the economic evaluation of iron ores is naturally in the first place their Fe content, although they can also be evaluated on the basis of their physical behaviour. The three ores which have been investigated here can be evaluated on this basis as follows: The Swedish ore expands between 800 and 1,000 deg., and contracts slightly between 1,000 and 1,200 deg. Fritting commences in a neutral or a reducing atmosphere at 1,100 deg. By the pressure of the surrounding charge, lumps of ore become slightly deformed at temperatures between 1,200 and 1,280 deg. The ore then melts in a neutral atmosphere at 1,500 deg., and in a reducing atmosphere at 1,400 deg. If it has not suffered reduction, it becomes first fluid at 1,530 deg. and free-flowing at still higher temperatures, should it be able to reach hotter zones in the furnace without undergoing decomposition. Since the ore commences to frit and soften only at high temperatures, it will remain loose and easy moving up to these temperatures. It is even conceivable that lumps can be raised almost to the melting point without sticking, and thus pass very far into the furnace without much deformation. This is clearly the reason for the well-known loosening or attenuating action of Swedish ore when mixed with lean ores which do not flow through the furnace easily.

In contradistinction, minette frits already at 1,000 deg., softens under pressure at between 900 and 1,200 deg., melts between 1,250 and 1,280 deg., and becomes viscous to semi-fluid between 1,280 and 1,330 deg. Although the Freiburg ore commences to frit already at 800 deg., *i.e.*, about 200 deg. lower than the minette, and hence exhibits a tendency to agglomerate, it softens under pressure at a temperature only 200 deg. above the minette. Very soon afterwards it melts and becomes free-flowing at a slightly higher temperature. Hence very shortly

Blast Furnace Conditions

after complete softening of the ore has taken place, it commences to run over the coke and lime. This behaviour also affects the running of the furnace, since the zone at which scaffolding may occur will be higher and colder than with richer ores. As shown by experiment, the spatial changes in the ores during fritting and sintering up to fusion can be very great; this factor has a direct bearing on the rate of transit of the ore through the various temperature zones in the furnace. Expansion of the ore signifies a slowing down of the transit rate, while a contraction means an acceleration. Premature liquefaction acts in the same sense. It is evident that the satisfactory or unsatisfactory behaviour of an ore during smelting in a blast furnace can be evaluated on some such basis as the above.

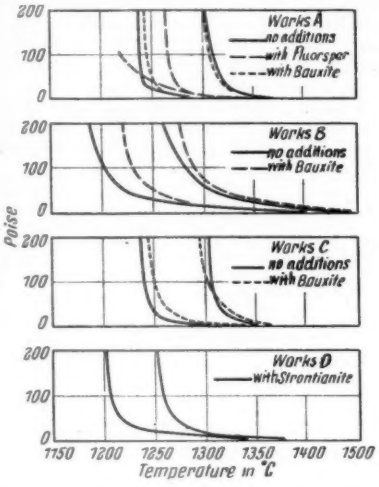


FIG. 4.—VISCOSITY RANGES OF OPEN-HEARTH SLAGS WITH AND WITHOUT FLUORSPAR.

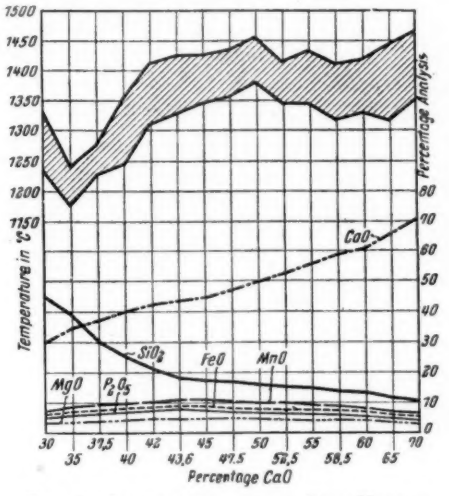


FIG. 5.—ISOVISCOSITY OF AN OPEN-HEARTH SLAG WITH INCREASING LIME CONTENT.

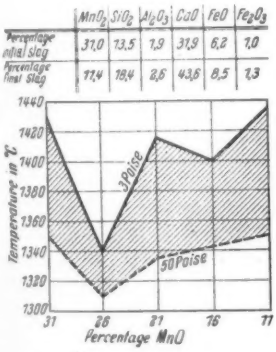


FIG. 6.—ISOVISCOSITY OF AN OPEN-HEARTH SLAG WITH DIMINISHING MnO.

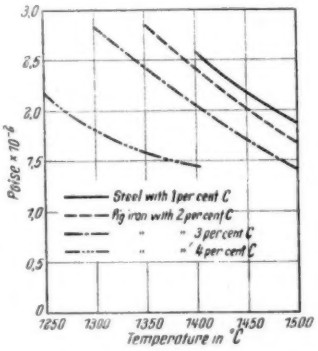


FIG. 7.—SOFTENING AND FUSION OF STEEL SCRAP. (THIELMAN AND WIMMER.)

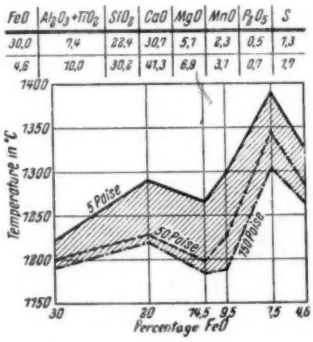

FeO Al2O3+TiO2 SiO2 CaO MgO MnO P2O5 S
30,0 7,4 22,4 30,7 5,1 2,3 0,5 1,3
4,6 10,0 30,2 41,3 6,8 3,1 0,7 1,9
Temperature in °C
5 Poise
50 Poise
150 Poise
Percentage FeO

FIG. 8.—VARIATION OF VISCOSITY OF A MOLTEN ORE ON FeO REDUCTION.

curves are shown in Fig. 4 for a variety of these slags, which were obtained after the addition of fluorspar, bauxite and strontianite. The liquefaction range of these slags lies between 1,180 and 1,450 deg., according to their composition and content of fluxes. It should be noted that these processes are also influenced by chemical interaction between the various components of the charge. If, for instance, a piece of slag on the point of fusion encounters a piece of lime during its descent, lime will be taken up, and as shown in Fig. 5 the slag mixtures will then become less viscous and more mobile according to the proportion of lime taken up,

Components other than Ore

As regards the conditions of fusion of the other constituents of the burden, it will be remembered that the charge under consideration contained in addition to the three ores, also mill scale, open-hearth slag, lime and steel scrap. Mill scale would appear to act similar to the high-grade Swedish ore, provided it is not reduced to metallic iron already at moderate temperatures; this is likely as the scale is very brittle and is easily reduced in size, then becoming the more rapidly reduced to iron.

Open-hearth slag being dense and vitreous is hardly attacked by reducing gases, and is found undecomposed, even in the low parts of the furnace, frequently in large lumps. On a further temperature rise, these slags fuse at very different temperatures. The viscosity although beyond a certain lime content it will again become more tacky.

To serve as an example, reference may be made to an open-hearth slag containing 30 per cent. MnO. Should a slag of this kind flow over strongly-heated coke, the MnO will be reduced. It was found in one blast furnace that owing to the evolution of CO the slag lumps swell. As the Mn content of the slag falls, the viscosity alters as shown in Fig. 6, assuming that this slag at the outset does not take up appreciable amounts of any other constituents. In the case under consideration the isoviscosity curves have a minimum at 26 per cent. MnO. On the other hand, a further drop in the Mn content as a result of reduction makes the slags more viscous again, such that these become stiffer until they reach the hotter zones in the furnace. Pure lime melts at 2,570 deg., so that at the temperatures obtaining in the blast furnace, lumps of lime do not suffer a change in shape. These lumps only become plastic when they have absorbed other constituents, a point which will be referred to again later.

Finally, the scrap softens under pressure at temperatures from about 700 deg. upward, and melts without taking up carbon at 1,500 deg., although the melting point is much lower if the scrap is carburised. Scrap bundles would thus appear to lose shape already at 1,000 deg., and are completely crushed by the grinding action of the heavy ore lumps at 1,150 deg. The viscosity curves of liquid iron with 1 to 4 per cent. C are shown in Fig. 7 as far as they have been plotted. Owing to the rapid carburisation in the blast furnace, only very little of the scrap charged with the burden would appear to remain as such in the 1,200-deg. zone.

Changes Lower in the Furnace

Some information can also be adduced regarding the changes which take place in the charge between the middle of the stack and the taphole. In these regions indirect and direct reduction predominate and iron and manganese in the slag phase are much reduced in concentration. Residues of the original charge remain which interact, thoroughly intermix and merge entirely together. An example of this is the liquified residue of a lump of ore, which at this stage would still contain 30 per cent. FeO, 30.7 per cent. CaO, 22.4 per cent. SiO_2, 7.4 per cent. Al_2O_3 and TiO_2, etc. The viscosity of this residual slag is shown in Fig. 8 on the left. If the ferrous oxide content is diminished by further reduction, the viscosity alters as indicated by the shaded surface from the left to right. The slag at first becomes viscous, then more mobile at 14.5 per cent. FeO, but at the same time also longer. On further reduction, the liquefaction range rises about 100 deg., so that the slag again becomes thicker with the temperature unchanged. At 4.6 per cent. FeO the viscosity of the slag is 150 poise at 1,250 deg., becoming 5 poise at 1,325 deg. This specifies the temperature zone in the furnace corresponding to these conditions.

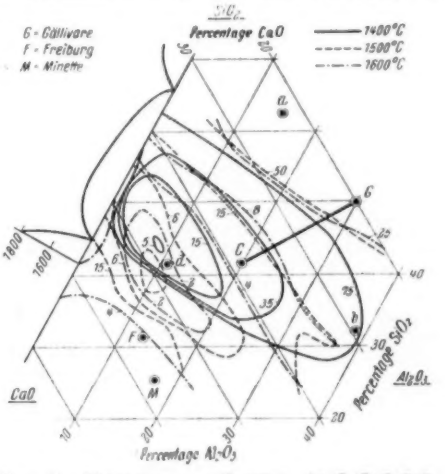


FIG. 9.—VISCOSITY OF SYSTEM Al_2O_3-CaO-SiO_2 AT 1,400, 1,500, AND 1,600 DEG. C.

The behaviour of isolated fused masses can be followed still further. Practically all the iron has been reduced from the three ores, leaving on the whole a mixture of lime, silica and alumina, neglecting any magnesia. The residues of the three ores have the compositions shown in Fig. 5. It should be noted that the Swedish ore alone, after complete reduction, can furnish an acid slag with a basicity ratio of 0.4, while the ratios with the other slags are 2.1 and 1.8 respectively, *i.e.*, they are basic slags. The coefficients of viscosity for the three-phase system CaO-SiO_2-Al_2O_3 have been exhaustively investigated, especially by American workers (Field, Royster, McCaffery, etc.), who have given the phase diagram shown in Fig. 9 with viscosities at 1,400, 1,500 and 1,600 deg.; the composition of the three ores concerned here are inserted. G denotes the residue of the Swedish

(*Concluded on page* 104.)

Casting Sewer Rings in Permanent Moulds

A production of 160-lb. cast-iron sewer rings and manholes at the rate of one casting every 15 mins. per machine in permanent mould machines of unusually simple design is being successfully accomplished by the Wagner Permanent Mold Company, Burbank, Cal. For the description of this machine we are indebted to the Editor of the "Iron Age."

The specifications for the sewer rings, which are set in the ground, are such that the natural,

FIG. 1.—PERMANENT MOULD MACHINE, SHOWING REMOVAL OF CASTING.

unmachined surface of the metal after cleaning is adequate for the use to which the rings are put, eliminating the need of a cope. The unit's drag section is permanently affixed to a foundation, while the core section can be raised and lowered to release the casting by means of a hydraulic hoist.

The joint between the two mould sections has a clearance of 0.002 in., which is adequate to prevent penetration of molten metal into the joint. Both sections are of semi-steel construction, with the core section hollowed out to eliminate weight and to aid in cooling.

Before casting, the mould sections are heated to about 150 deg. C. and coated with a refrac-

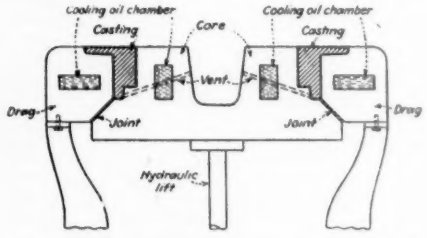


FIG. 2.—CONSTRUCTIONAL FEATURES OF THE WAGNER PERMANENT MOULD MACHINE FOR CASTING 160-LB. SEWER RINGS.

tory material. After pouring (see Fig. 1 for gate construction), the metal is allowed to cool for a definite length of time, then the core section is lowered and the casting removed.

This cooling period is critical and must be followed closely to prevent cracks due to contraction of the casting over the core during solidification. After each pour, the mould is coated with refractory material, but no other treatment is required. Risers are not used.

The cooling of the moulds is accomplished by circulating oil by gravity through the cooling chambers (see Fig. 2) which encircle both core and drag. After passing through a mould section, the cooling oil drains into a cooling basin, from which it is pumped to a tank above the mould. It is then fed back to the moulds by gravity. A control valve placed in the return line regulates the volume of oil passing through the cooling chambers, and in this manner makes possible maintenance of a steady temperature of the moulds.

The machine illustrated here was designed primarily to cast sewer rings weighing 160 lbs. and measuring 2 ft. 6 in. in diameter. Other units of similar design, however, are being used to cast aluminium parts weighing up to 54 lbs. Aluminium is poured at 723 deg. C. and iron at 1,370 deg. C.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

"Moulding Problems in Electric Steel Foundry"

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In reply to the comment made by Mr. W. L. Hardy on the paragraph on "Green-Sand Moulding" in the above Paper, and published in your issue of January 15, the first statement made relates to the standard practice employed by the foundry concerned. Mention of the term "not much machining" does not necessarily mean rough work. On the contrary, the effort is to produce good, clean, serviceable castings in whatever method adopted. However, a keen interest is being taken, and experience gained, in the production of castings in the manner described by Mr. Hardy, and several tons are cast daily.

But, appreciating further achievement for this method with full foundry co-operation, to claim success at this period would, I feel, be premature.

My thanks are due to Mr. Hardy for raising the matter, which is of interest to the enterprising steel-foundryman.—Yours, etc.,

E. G. KELLY.

Pontypridd.
January 24, 1942.

Plaster Patterns

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I have read with interest the Paper by Henry Plucknett in your issue of January 15, which I consider a good description of the use of plaster of paris for making temporary patterns.

In reading the letter by W. Wearing in the Journal of January 29, commenting on the Paper, I am surprised at the lengthy discussion on the method of building up a pattern for a 20 in. dia. cylinder, 9 in. long.

Surely the most economical and quickest way would be to form the mould by means of strickles, either in loam or sand. In the case of the longer cylinder, 20 in. dia., 3 ft. long, a core pattern the diameter of the core with the thickness laid on in loam in the centre would serve for the pattern. Removal of the thickness would leave a core which would fit back into its own print and give a central core. Of course this core would be struck up on a core barrel with loam. If more than one casting was required the core pattern could be retained for all, separate cores being struck up for the castings except the last, for which the core pattern would be stripped.

Yours, etc.,

"ECOSSAIS."

February 3, 1942.

AT THE ANNUAL EQUIPMENT NIGHT of the Metropolitan Chapter of the A.F.A. on December 1, four 15-min. talks were presented on mechanised foundry equipment, viz., foundry furnaces, sand preparation equipment, moulding machines, and casting cleaning equipment. National President H. S. Simpson stressed the need for educational programmes on all types of foundry practice because of the rapid expansion of the profession in national defence.

Ministry of Production Formed

A Ministry of Production has been set up by the Government, and Lord Beaverbrook transferred from the Ministry of Supply to become Britain's first Minister of War Production. His task will be to ensure that the fullest use is made of industrial capacity and labour in the interests of the war effort, and according to a White Paper issued this week, he is charged with the prime responsibility for all the business of war production in accordance with the policy of the Ministry of Defence and the War Cabinet. He will carry out all the duties hitherto exercised by the Production Executive except only those relating to man-power and labour. His duties will include the allocation of available resources of productive capacity and raw materials (including arrangements for their import), the settlement of priorities of production where necessary, and the supervision and guidance of the various departments and branches of departments concerned.

Lord Beaverbrook's place as Minister of Supply has been taken by Sir Andrew Duncan, hitherto President of the Board of Trade. Sir Andrew Duncan joined the Government as President of the Board of Trade at the beginning of 1940. For this purpose he left the British Iron and Steel Federation, of which he had been independent chairman for some time. He served as Minister of Supply from October, 1940, to June, 1941, when he gave way to Lord Beaverbrook and returned to the Board of Trade. Col. J. J. Llewellin has succeeded Sir Andrew Duncan at the Board of Trade.

Physical Conditions in the Blast Furnace During Smelting

(*Concluded from page* 103.)

ore, M the minette, F the Freiburg ore. The viscosity of the residual slag of the Swedish ore (point G) at 1,400 deg. would thus be 100 poise, at 1,500 deg. 60 poise, and at 1,600 deg. roughly 30 poise. This slag would hence not be free-flowing even at 1,600 deg. The viscosities of the two other residual slags at these three temperatures can be similarly deduced from the diagram.

Residual slags of this character react with each other, and this affects the viscosity conditions. Further, when these residual slags come in contact with lumps of lime, they dissolve the latter with increase in their lime content. In the case of the Swedish ore, the line G-C would then apply, and the respective viscosities could again be read off from Fig. 9. If, for instance, the residual slag from the Swedish ore had taken up too much lime, so that its composition corresponds to point C, the viscosity of the slag formed would be 25 poise at 1,400 deg., 10 poise at 1,500 deg. and 6 poise at 1,600 deg. It has thus become much more mobile, this being, of course, the principal object of adding lime, other than to effect desulphurisation.

The viscosity conditions for the corresponding four-phase system CaO-SiO_2-Al_2O_3-MgO have also been studied, and with their aid it is possible, at least to a first approximation, to deduce solution in the residual slags of the ores or also the effect of the solution of coke ash in the other residual slags. Peculiar melting conditions occur when ore fines are blown into the lower parts of the furnace, since the ore is here immediately fused without passing through a partial reduction stage. Reduction then takes place exclusively in the fused state.

Although no measurements were made of the volatilisation of the various constituents of a charge, it is obvious that volatilisation is important when smelting certain zinkiferous and arsenical ores.

The Present Status of Chilled Iron Rolls

A SURVEY OF PRODUCTION AND SERVICE CONDITIONS

By ARCHIBALD ALLISON

The scientific study of chilled iron rolls is of comparatively recent origin so far as records have been published. Apart from Papers relating experiences, and deductions drawn therefrom, and the analysis given by Prof. Turner in 1887, the earliest detailed account of scientific applications is that of De Loisy in "Revue de Metallurgie" in 1905. That Paper is of particular interest because it describes what may be done by metallurgists in remote places far removed from regular sources of supply, to meet their own needs by manufacturing on the spot; and there may be other instances not recorded. Whilst the analyses in the Paper are not always accurate, sufficient evidence is given of scientific application to a difficult technical production, and the Paper appears to be the first record of making and using synthetic irons.

The classical Paper by Dr. Schuz in 1922 in "Stahl und Eisen" is definitely a thorough scientific investigation complete with chemical and physical records, although the conclusions reached have naturally been modified by later work.

Personal Judgment in Manufacture

It is agreed by those with experience that chilled iron rolls can only be produced by the application of such technical resources as are available supplemented by personal judgment—the human factor cannot be eliminated so completely as in other ferrous productions. The early manufacture seems to have been successful incidentally rather than deliberately because the only iron available, cold blast, was suitably low in carbon and silicon, and the only melting unit for large quantities, the air furnace, tended to reduce the carbon further, producing a mild roll of a durable character.

Current opinion upon carbon contents has changed considerably in the last decade. It was thought that for severe usage such as rolling thin sheets, tinplate and strip steel, a mild roll was essential to avoid surface cracking and breakage. It was recognised that rolls cast from cupola metal were higher in carbon but were quite satisfactory for some purposes such as cold rolling metals and for the food, paper and textile industries. Two definite points have emerged from the studies so made,* that rolls which have been seasoned or aged for some months are less likely to fail, and that decided improvement is effected by carefully preheating the rolls prior to the commencement of operations. The natural deduction is that rolls could well be stored in readiness in a hot room to accelerate stress relief, and to provide rolls preheated and soaked for the hot mills.

Melting Practice

Research into cast iron has shown that cupola iron besides being higher in carbon has also coarser graphite in the grey centre, produced by the rapid rate of melting and apparent inoculation from some cause not yet discovered, but suspected to be derived from contact with the coke. On the other hand, melting in hearth furnaces of various types, apart from somewhat lower carbon according to the mixture charged, gives time for the inoculating agent to be dissolved and rendered inactive. Therefore with such iron a higher carbon is welcomed from the increased surface hardness produced, without the graphite of the interior being coarse.

The various types of melting furnace now available, with the exception of the electric furnace, all suffer from the drawback that more carbon is lost than desirable, and cannot be replaced, although an American claim has been put forward that crushed anthracite will serve in this direction, when added to the streams in tapping. Duplex processes of melting in the cupola and superheating in a hearth furnace are practised to some extent, but generally a higher carbon iron is desirable for cold charging in the hearth furnace to allow for loss in melting. This is the reverse of the older idea that low-carbon pig-iron is more desirable.

The metallurgical problem is therefore to charge a mixture with sufficiently high carbon, using as melting stock old rolls which of necessity have only medium carbon, together with new iron to correct losses, and this is frequently by no means easy with some pig-iron. The practical problem of melting down large masses of suitable metal, such as some worn-out rolls, has also yet to be solved economically. The air furnace—historically the oldest furnace for melting pig-iron—is extraordinary in that the large pieces are charged into the cold or almost cold furnace, and the men go inside to arrange the melting stock in the best position. The melting campaign is a one-day affair.

No Specification for Chilled Rolls

No specification has yet been devised for chilled rolls except the surface hardness measured by the Shore scleroscope, and in the absence of positive carbon control this is not always attainable. It is reported that in some countries where economic conditions justify the use of the electric furnace, melting can be effected without appreciable loss of carbon, complicated by irregular correlation between the chill test readings on samples from the molten bath, and the chill depth measured on the rolls cast.

With regard to making physical tests on rolls to correlate with service as is done with so many manufactured products, this is out of the question with castings like chilled iron rolls. No test-piece can be excised or detached, nor tested if it could be obtained. Apart from analysis, measurement of chill depth and surface hardness, there are no tests which can be usefully applied. Some rolls have been magnetically tested with iron powder suspended in liquid, but only revealed slight local variations of composition which subsequent service showed were of no account. The ultimate resort, therefore, is statistical or bulk research, which has been carried out where circumstances permitted in some works. Statistical research has already pointed the way to improvements in unexpected directions in some steel products and ingot moulds, for instance.

Roll Information as Guide to Mill Management

The question has been asked that types and qualities should be laid down as suitable for particular purposes in rolling mills, as a guide to the management. This, again, is difficult of achievement, because mills vary so widely in the product rolled, finish required, class of steel, heating arrangements, skill of the workers and treatment of the rolls. Statistical information derived from the records of each mill would be very useful, but not comparable with other mills even in the same works. For example, in a mill rolling strip steel a life of 2,000 tons is considered satisfactory, in view of the class of steel and finish demanded. In another mill 7,000 tons is the usual life, but on another class of material and different finish demands. A parallel illustration is the number of casts to be expected from ingot moulds. A works making highest class steel will scrap moulds which would be used twice as long in works producing a different grade. If every roll is given a number and registered according to its position in the mill, and the tonnage ascertained for each occasion it goes into service, useful information as to reasonable life and comparison with different types may be obtained. This is apart from mill casualties, such as incorrect setting, cold ends, tongs slipping through, overdrafting, stickers, etc., which are extremely difficult to detect and record, since the damage does not always reveal itself until subsequent working shifts.

The defect known as "spalling" when pieces of chill break out can invariably be traced to previous damage from one or other of the above causes, although hitherto the roll-maker has usually been called upon to bear the responsibility. To quote Mr. W. R. Lysaght's presidential address to the Iron and Steel Institute in 1933, speaking both as a maker and user of rolls:—"My considered opinion is that the great bulk of breakages is caused by treatment received in the mill."

Chemistry of Chilled Rolls

The chemistry of chilled rolls operates within far wider ranges than many ferrous products. Each element may be regarded as an alloy to be manipulated to suit the particular purpose, without being palpably detrimental. Carbon is naturally the supreme hardening element even in alloy rolls, which are even more sensitive to its influence within their range of composition and hardness than plain rolls. Silicon is equally the graphitiser, that is, in producing the inverse of chill. Manganese, in the amounts usually found, merely serves the purpose of stabilising the sulphur, which thereby seems unimportant in its effects upon the roll otherwise, although Breitenbach* quotes German opinion that 1.8 per cent. manganese may be used safely, others giving 1.2 per cent. as the limit, himself preferring 0.8 per cent. as a maximum. These figures clearly reflect the composition of the native irons. The same author, a practical roll maker, refers to the "world celebrity of English chilled rolls," and attributes this to the "excellence of new and old material available in England, but not in Germany," together with coke low in sulphur. He also states that "the purchase of chilled rolls is a matter of confidence," that "rolls are not market articles." Probably other German metallurgists have found means to employ local irons to produce more orthodox compositions.

Phosphorus is definitely useful from the consideration of giving casting fluidity, and healing slight pulls and blemishes which may be produced in casting. Medium-sized rolls have given excellent service with phosphorus percentages ranging from 0.28 to 0.65 per cent.

Cooling Characteristics

Behind the chill of any roll there is a zone of mottled iron greater or less in depth according to composition, but the mass of even a small roll is sufficient to over-ride any effect the phosphorus might have in extending this zone by maintaining a longer period of fluidity. On the other hand, in very small chilled castings, where it is essential to have a white iron surface and grey interior, the contest between the cooling action of the chill and greying action of the heat of the interior metal is so acute that very low phosphorus is necessary to avoid producing a casting either all white or all grey, so that there is a sharp division between the white and grey. Long experience shows that alloys generally, and low carbon in particular, produce lag in two ways.

The difference in recorded chill between the test-piece and the rolls is greater, and the roll itself has a deeper zone of mottle behind the chill. In some large sheet mills it is the practice to wear out the chill on finishing work, and then to turn off the remaining chill and use the fine mottle for roughing purposes, for which it is excellent. The deeper zone is naturally produced by alloys which slow up the change points, and by low carbon, because the less carbon there is present, the more slowly does it precipitate, since the solution is less saturated.

The question of time effects on change points and variation due to alloys has not been worked out, but the practical results are fairly evident. Mild rolls, that is with low carbon, have a very uncertain demarcation between chill and grey. In fact it is possible to detect very fine graphite by microscopic examination in material which the skilled eye of the roll turner would call strict chill. In rolls of the semi-chill type where the working surface is below the strict chill, the material is really a very fine mottled iron with fine graphite, producing a durable quality excellent for many purposes although softer than strict chill. There is also the value derived from the presence of graphite, which in these rolls greatly assists turning, and in rolls generally supplies a cushioning effect against thermal and mechanical shock in a material so naturally unyielding and rigid.

Alloys in Chilled Rolls

While alloys have been used in small amounts in chilled rolls for many years, progress has been

* Caswell, South Wales Institute of Engineers, 1930.

* Giesserei Zeitung, December 15, 1930.

Chilled Iron Rolls

slow on account of the responsibility attached to failure, and change of technique in the relation of test-piece to roll. Chromium must be used with great caution on account of its strong whitening effect in such a rich alloy as cast iron, rich in the sense that the effect of the sum total of the modifying elements is so little below the saturation limit for carbon for a given depth of chill. The use of a strongly stabilising element like chromium, as regards carbon, calls therefore for higher contents of a graphitising element such as silicon to produce the balanced reaction read as depth of chill. The average of many analyses shows that to add about 0.35 per cent. chromium the silicon must be raised about 0.1 per cent. to produce the same depth of chill on the roll, but the ratio of 1-3 does not apply when larger amounts of chromium are used. Slight increases in hardness and toughness are produced by this small addition.

The demand for higher-duty rolls both as regards hardness and durability is being met to some extent by employing high percentages of both chromium and nickel, although the technique has not yet been worked out to standardisation. The addition of alloys calls for close scientific control of all elements, and a careful study of the relationship of the chill test to the size of roll to be produced, because on neither test-piece nor roll is there any definitely marked chill depth.

"Indefinite Chill"

The type of roll sometimes described as "indefinite chill" falls into two classes. First the useful semi-chilled roll purposely cast with shallow chill, because the useful working surface or section is formed in the fine mottled zone underneath the chill, which is actually turned off more or less completely. Secondly, the alloy rolls which again fall into two groups for hot or cold rolling. The fields of operation for rolling foodstuffs, paper and softer metals seem to be adequately dealt with by plain chilled rolls.

For hot-rolling sections when a deep chill can be given to a roll without the neck being more than mottled, plain chill metal is suitable, although the difficulty of producing deep chill without being too deep or too shallow for the particular diameter of roll, is well known to be very great. For certain difficult sections where deep gates seriously reduce the mechanical strength of the rolls, the indefinite chill type with low alloy contents is particularly useful, and might well have a wider application. Ease in turning and greater strength with less heat susceptibility are further advantages.

Demand for Harder and More Durable Rolls

The demand for more intensive use of mill machinery has produced a need for harder and more durable tools to withstand higher pressures and speeds, and in fact the mills have been developed in power much more than the ability of the working tools to withstand the increased duty.* The harder roll demanded to avoid tail marking, roll changing and dressing, has been supplied by the use of alloys such as nickel and chromium. It is difficult to cast a roll with a higher scleroscope test than 65 in plain iron, but fairly high percentages of nickel and chromium enable rolls to be cast with 80 scleroscope or upwards in medium size rolls. Very small rolls in the cast condition have given 100 scleroscope hardness, but since the limit of machinability with carbide tools is about 86 scleroscope, tempering is necessary unless the necessary trimming and shaping can be done by grinding. Heat treatment of rolls is now regular practice and is essential, because types of roll are now made which are white through, that is with very little, if any, graphite, even in the centre. It is obvious that white rolls, even though low in carbon almost down to 2 per cent., can hardly be used without stress relief and toughening—they are still white cast iron. What may be called, on the whole, more regular types of roll with the additions of alloys have been used with fair success in both hot mills and cold mills.

The metallurgical aspects of these alloyed rolls have been dealt with fairly extensively by Coyle,† Griffiths, Everest, Hanson, Taniguchi, and others, but on account of the responsibility involved in producing castings which are either good or bad, and if apparently sound, may meet with disaster in heat treatment, or in early use in the mills, progress will be a matter of proceeding step by step, taking all factors into consideration. Large scale experiment, the only practical method, calls for considerable courage.

Casting Difficulties

An illuminating discussion of the casting difficulties appeared in "La Fonte," September, 1939, suggesting means for dealing with contraction stresses, although the author does not state how the recommended percentage of carbon 3.3 per cent is to be attained. With 3 per cent. nickel and 1 per cent. chromium the chill of these rolls is more or less martensitic in structure, according to the size, and the consequent self-tempering of larger masses. With less amounts of alloys the rolls are still harder than plain chill, giving 70 to 75 scleroscope.

The addition in greater amounts up to 4.5 per cent. nickel and 1.5 per cent. chromium produces a chill which is martensitic in structure and therefore much harder, but at the same time greatly increases the responsibility both of the roll-maker and the user. A higher temperature of casting is necessary, and there is greater contraction on cooling causing liability to pulls and splits.

Long and slow cooling is desirable, and although with careful usage the rolls can be used as cast, it is considered safer to give a stress-relief treatment, or tempering, which must be done with extreme care and very slow heating, as the material seems to be particularly sensitive to temperature gradients. It has been stated that the austenite-martensite change may occur at low temperatures, and is accompanied by volume changes, so that a long period of treatment at a temperature of only 350 deg. C. is needed to achieve stabilisation of structure in so sluggish an alloy. Alternatively, as soon as may be after cooling, possibly three hours, the rolls may be stripped from the mould red-hot—an arduous task—and removed to a furnace with controlled temperature, and permitted to cool at a measured rate for three days.

It has long been recognised that for producing plain chilled rolls, a specialised equipment including heavy lathes is required, and from the above it is clear that the alloy rolls require for production, besides massive lathes, the use of carbide tools, and suitable furnaces for heat-treatment, as already indicated.

Revision of Casting Structure

To obtain real revision of casting structure, heating to a temperature of over 900 deg. C. is indicated. For hardening, any other treatment than air-quenching is obviously out of the question with such massive circular objects of varying sections, and of such rigid material as cast iron. Further, when the air hardening has proceeded to the desired extent, measured by time, tempering should be done by replacing the roll in a furnace of suitable temperature and permitting it to cool slowly over a period of three days or longer.

Three other possibilities may be employed: (1) To permit the casting to cool overnight to a temperature, according to size, of 350 deg. C. or less, and then place in a furnace at the same temperature for very slow cooling; (2) to allow the casting to remain in the pit until almost cold, and then transfer to a furnace for cautious heating up to 350 deg. C., or thereabouts, for prolonged tempering or stress relief; (3) to reduce the percentages of alloys whereby the rolls whilst less hard are more robust.

To produce martensitic chill, a nickel content of 3 per cent. is required with corresponding 1 per cent. chromium in medium-sized rolls. The hardness demanded by service can thus be produced by adjusting the alloy content to the size of roll. Small rolls with nickel under 3.5 per cent. and chromium 1.00 per cent. yield a satisfactory hardness in the cast state and this may be only slightly lowered by tempering.

It will be seen that these treatments are applicable to three types of roll, the fully hard roll for cold rolling, the medium hard for hot rolling, and small rolls with lower alloy content for cold rolling. The rolls are stated to be mechanically stronger than plain rolls, and for cold rolling metals, can in some cases compete with hardened steel rolls, which are themselves notoriously difficult to produce.

Alloy Rolls in Service

So far as service is concerned, alloy rolls, if the first few shifts are survived, give a long and satisfactory life, requiring fewer dressings and less frequent changing, but mysterious and unexplained failures occur from time to time. For instance, a pair of rolls from one cast may be put into the hot mill. Within a few hours or less, one roll breaks, but its fellow, cast out of the same actual ladle of metal may ultimately yield a very satisfactory life. The conclusion might almost be hinted at that the hot rolling mill is a clumsy machine using very sensitive tools.

Many fractures have been studied and photographed, without revealing any crack or blemish from which failure could start. In the case of cold mills when fractures occur, it would be useful to examine the actual piece of metal being rolled—if it can be found.

It will be noticed that these hard rolls have hitherto been used only for flats and strips, because sections, unless very shallow, would introduce complications in turning, and the possibility of cutting into metal not sufficiently strict chill.

Roll Design

Considerable criticism might well be put forward on the design of rolls, which in some cases have extraordinarily long necks and bearings and sometimes elaborately machined changes of diameter. Since even a high-duty roll is at best a temporary part of the mill, expensive machining operations can only be regarded as wasteful expenditure, unless there is well-proved justification for them.

Upon one point there seems to be general agreement that for the working rolls of four-high cold mills, hollow rolls in alloy cast iron do not possess sufficient fatigue resistance, so that the central cooling chamber must be dispensed with. Even hollow rolls of hardened steel frequently fail by progressive fracture originating from the central hollow provided for water-cooling.

For most purposes in which chilled iron rolls are used, other than for rolling metals, the plain chilled iron will probably be satisfactory, as renewals are infrequent. For cold-rolling the more refractory metals, the alloy iron rolls have been found very useful, as they can be ground to give a high finish which is fairly durable. As far as hot mills are concerned, there is one factor which has to be worked out, *viz.*, whether it is more economical to use an expensive roll with higher output and requiring few dressings, or cheaper plain chilled roll with more frequent renewals.

Finally, it seems to be established by experience that whatever care be taken in producing a few pairs of rolls, and observing their life in service, no positive conclusions can be arrived at as to the factors governing success or failure, so far as the rolls themselves are concerned. Definite indications can only be found from the records of a considerable number of a type, which amounts to statistical investigation.

* Russell and Smith. Journal, Iron and Steel Institute, 1936, vol. II.

† "Foundry Trade Journal" June 6, 1933

A.S.T.M. Coal and Coke Standards

In his report of A.S.T.M. Committee D-5 on coal and coke, A. C. Fieldner, the chairman, states that the tentative method of test for index of dustiness of coal and coke is recommended for adoption as standard, and the committee is proposing the withdrawal of the tentative definition of the term coke and the standard specifications for foundry coke. Considerations being given by the committee to a procedure for determining ash of coals unusually high in calcite and pyrite, a method for determining specific surfaces of pulverised coal, sampling of coal for determination of total moisture, and factors effecting the ignitibility of coal and coke are discussed. The report was submitted at the recent meeting of the American Society for Testing Materials held at Chicago.

"Copacite" Sulphite Lye Powder

Sulphite lye has been widely used for many years as an ingredient in the manufacture of core binders and silica refractories. It is recovered as a by-product in the production of wood cellulose by the sulphite process, and owing to the heavy restrictions in the paper industry, has become increasingly short in supply since the outbreak of war. "Copacite" sulphite lye powder, distributed in the British Empire, excluding Canada, by Trenmans, Limited, "Rivermead," Thames Street, Sunbury-on-Thames, Middlesex, is manufactured by the St. Maurice Valley Paper Company, Limited, Montreal, and results from the calcium process. It retains its finely powdered condition without caking during storage. This additional Canadian supply is a most useful contribution to the war effort.

Mechanical Properties of Iron-Manganese Alloys*

F. M. WALTERS, I. R. KRAMER and B. M. LORING, in the course of a Paper on "Iron-Manganese Alloys" to the American Institute of Mining and Metallurgical Engineers, state that no observations on the mechanical properties of iron-manganese alloys have been published since pure manganese became readily available, either distilled manganese or electrolytic manganese. The purpose of their investigation was to determine whether iron-manganese alloys are essentially brittle, as reported by Hadfield in 1927, or whether the lack of ductility observed was due to impurities in the alloys that he studied.

The alloys were melted in a 100-lb. high-frequency induction furnace with a magnesia crucible, using ingot iron and electrolytic manganese. The heats were split, the first giving six 18-lb. ingots and the second three. Each successive heat was higher in manganese, and about 0.3 per cent. silicon was added as ferro-silicon. The alloys forged without difficulty, and were given a 90 per cent. reduction to ¾-in. rounds. The chemical analysis of the alloys is given in Table I.

TABLE I.—*Chemical Composition of Alloys.**

Alloy.	Mn	C	Si	S
	Per cent.	Per cent.	Per cent.	Per cent.
A	3·74	0·04	0·12	0·021
B	6·66	0·04	0·11	0·019
H	8·80	0·03	0·05	0·016
C	9·60	0·03	0·09	0·019
J	11·54	0·03	0·08	0·014
D	12·93	0·03	0·08	0·016
K	14·04	0·03	0·06	0·012
E	16·29	0·03	0·07	0·013
F	20·51	0·03	0·07	0·013
G	20·70	0·02	0·01	0·017

* Phosphorus less than 0·001 per cent.

The forged rods were homogenised for 24 hrs. at 1,150 deg. C. and air-cooled. The alloys were tested in two conditions of heat-treatment: (1) as normalised from 870 deg. C., and (2) normalised from 870 deg. C. and tempered for 1 hr. at 540 deg. C. and air-cooled.

The tensile specimens were 0.505 in. with a 2-in. gauge length, and the impact specimens were V-notch Charpy. The proportional limit and yield strength were taken from the stress-strain diagrams drawn by a Peters recorder. The data obtained from the tensile test and the hardness measurements are given in Table II. Specimens that were normalised are designated by N; those that were normalised and tempered by T. Alloy G was tempered after forging (D).

Discussion of Results

The mechanical properties of the iron-manganese alloys (Table I) are not unexpected when their constitution is considered. Up to 10 per cent. Mn, the austenite transforms to ferrite, but at a progressively lower temperature as the manganese is increased and the fine ferritic grain size and strain resulting from the low-temperature transformation give increased strength and decreased ductility in the normalised condition. Above 14 per cent. Mn, the austenite transforms partly to the hexagonal close-packed phase, epsilon, and the alloys show the low elastic limit and high ductility characteristic of austenitic alloys. Between 10 and 14 per cent. Mn both ferrite and epsilon are formed by the decomposition of the austenite, and the highest strength of the series of alloys is shown by those in this range.

The effect of the tempering at 540 deg. C. was to raise the ductility and lower the tensile strength in the 6.66 and 9.60 per cent. Mn alloys, but both the ductility and the strength of the 12.93 per cent. alloy were increased by tempering.

Since the temperature of the transformations of the binary iron-manganese alloys and the completeness of the transformations have been found to be little affected by the rate of cooling, air cooling was the only rate employed for these experiments. It is believed that the results obtained would not have been materially different if other cooling rates had been used.

Instead of being brittle, most of the iron-manganese alloys actually are more ductile than S.A.E. steels of the same tensile strength. No reason has been found for the low elongation shown by alloys F and G. Alloys of this composition (20 per cent. Mn) have substantially the same constitution as the 16 per cent. alloy; that is, in both about one-third of the gamma has transformed to epsilon.

The brittleness of Hadfield's alloys was probably due to their fairly high carbon and phos-

(*Continued at foot of next column.*)

TABLE III.—*Charpy Impact, V-notch.*

Alloy.	Mn. Per cent.	Normalised.*	Normalised and tempered.
A	3·74	22, 8†, 19‡	156, 154
B	6·66	5, 7	85, 89
C	9·60	6, 8	70
D	12·93	34, 38	71, 75, 80
K	14·04		120, 127
E	16·29	191, 197	127, 149, 112
F	20·51	78.† 87	72, 69

* All made at 21° C. (70° F.) except as noted.
† Tested at 3·5° C.
‡ Tested at 100° C.

TABLE II.—*Mechanical Properties of Alloys*

Alloy.	Mn, per cent.	Proportional limit, tons per sq. in.	Yield strength, 0·2 per cent. Tons.	Tensile strength, Tons per sq. in.	Elongation, per cent.	Reduction in area, per cent.	Hardness Rc.	Brinell Hardness No.
A-N	3·74	28·2	33·4	37·9	27·3	72·5	16	163
A-N		28·5	34·8	37·9	27·1	78·0		
A-T		22·1	28·4	32·2	32·0	80·0	14	159
B-N	6·66	40·2	52·2	53·6	14·0	51·7	20	241
B-N		40·2	52·4	53·6	12·5	50·0		
B-T		28·2	36·9	41·1	25·0	62·3	18	187
H-T	8·80	40·2	46·4	49·3	25·0	74·5	22	235
H-T		36·2	43·5	47·5	27·0	73·7		
C-N	9·60	43·2	54·0	61·5	16·4	62·1	28	266
C-N		43·2	54·0	61·3	3·1	7·7		
C-T		31·5	46·0	52·6	27·0	70·1	20	235
J-N	11·54	23·5	39·0	65·0	18·0	47·9	30	277
J-T		19·6	44·0	67·0	25·0	65·4	34	302
J-T		21·0	43·3	67·0	27·0	66·8		
D-N	12·93	39·3	47·0	56·0	6·3	14·1	28	262
D-T		14·8	31·8	62·4	29·0	70·4	29	285
K-N	14·04	16·3	24·0	52·0	25·0	69·4	20	229
K-T		10·9	26·3	55·4	32·0	71·8	21	212
K-T		10·9	25·3	55·4	32·0	69·5		
E-N	16·29	13·1	19·3	40·0	32·0	38·2	16	217
E-N		15·4	20·1	40·2	28·1	37·3		
E-T		13·2	23·5	41·2	40·0	59·0	17	210
F-N	20·51	14·8	20·1	46·5	12·5	14·8	20	217
F-N		15·4	20·1	48·8	15·6	15·2		
F-T		9·4	23·2	49·6	20·0	27·2	20	217
G-D				52·0	19·0	28·0	22	212
G-D				56·8	20·0	29·2	22	217
G-T				53·6	18·	24·8	21	207

Young's Modulus of Elasticity and Related Properties of Graphitic Materials

DR. H. A. SCHWARTZ and MR. C. H. JUNGE, in a Paper on Young's modulus of elasticity and some related properties of graphitic materials, which they presented to the forty-fourth annual meeting of the American Society for Testing Materials, have drawn the following conclusions:—

(1) Young's modulus of elasticity may be satisfactorily measured either by fitting the best straight line to a stress-strain diagram or by observing the stress-strain relation on repeated loading and unloading between the limits 1 and 5 tons per sq. in.

(2) The latter method is perhaps preferable both on account of ease of execution and consistency of result. (3) The results by the latter method will be consistently somewhat greater than by the former. (4) In the absence of recombination of graphite in the heat-treating process, modulus of elasticity for materials having all their graphite as temper carbon, and graphite content are linearly related.

(5) In all materials containing only the temper carbon form of graphite, modulus of elasticity and density have a close linear relationship. (6) Graphite in the flaky form decreases modulus of elasticity much more than an equal amount of temper carbon. (7) These principles may perhaps form the basis for quantitatively expressing graphite form. (8) The re-solution of carbon from cementite is enormously faster than from graphite.

(9) Empirical equations are given correlating resistivity and coercivity with carbon content which probably have little theoretical significance. (10) When graphite exists only as temper carbon, that is, when the metallic matrix is interrupted only by approximately spherical voids and/or inclusions, modulus of elasticity is directly proportional to the amount of metallic phase in a unit volume.

Specifications for Cast Iron

In view of a number of inquiries they have received concerning the specification position for cast iron, the British Standards Institution have asked that the attention of all members of the Institute of British Foundrymen should be drawn to the following publications on this subject:

(*a*) B.S. 321, "General Grey Iron Castings," covering Grades A and C.

(*b*) B.S. 786, "High-Duty Iron Castings," covering Grades 1, 2 and 3.

(*c*) CF (IS) 7943, a war emergency revision to B.S. 786, and covers Grade 4.

(*d*) B.S. 991, "Data on Cast Iron," summarising the above specifications and giving additional data on the properties of cast iron, including grey and white irons, malleable and alloy cast irons.

The attention of members is drawn especially to the last of these publications, which has been prepared by the Technical Advisory Panel to the Directors for Iron Castings, since this contains the information now placed in the hands of the various Government Departments interested in the design and specification of iron castings. All the foregoing can be obtained direct from the British Standards Institution, 28, Victoria Street, London, S.W.1.

(*Continued from previous column.*)

phorus content (0.06 to 0.15 and 0.044 to 0.070 per cent.). Furthermore, the heat-treatments (as forged, annealed, and water-quenched) did not include tempering, which has been found to be necessary to develop the best ductility in some of the alloys.

Recent Japanese Iron and Steel Developments

IMPORTANCE OF MANCHURIA

Both in Japan Proper and in Manchuria, the Japanese authorities have for some years put into operation five-year plans for the development of various industrial projects, including, as a keystone, the iron and steel industry. This summer the details of the second five-year plan for this industry were under discussion in Tokyo between the Government and the Japanese Iron and Steel Control or Tekko Tosei Kai, according to the last reports received from our Yokohama correspondent. The programme under discussion included the development of iron and steel production in Japan Proper, Manchuria and the occupied parts of China as an indivisible whole, the output from each area being diverted into those channels best satisfying Japan's needs for armaments, etc. There appeared to be much divergence in opinion as to which area should be developed to provide the bulk of the output, the Director of the Control still favouring the enlargement of pig-iron producing facilities on the mainland of Asia, while Japanese iron and steel-makers considered there should be an equal division between Japan and Manchuria. The Director based his views on the urgent need for strengthening and completing national defence plans—also the main plank of the first five-year plan—as in both peace and war Japan would require a considerable tonnage of iron and steel. According to his views, no further blast furnaces could be erected in Japan and pig-iron production must therefore be localised more and more in Manchuria as well as in other parts of occupied China, while Japan herself should turn her main attention to the provision of more steel-finishing capacity. The problem of supplying the Japanese iron and steel industry with raw materials is at the root of this view. Manchuria possesses extensive deposits of iron ore, although lean, and adequate coal resources. Labour is also cheap both there and in the more southern areas of China. Conditions in Japan Proper are, on the other hand, not very favourable for erecting additional blast furnaces.

Our correspondent draws attention to the position of charcoal iron output in Japan. There are six works making this iron, the Turigami works of the Hitachi Seisakusho, the Hachinohe works of the Sakurai Seitetsusho, the Takemori works and the Kake works of the Teikoku Seitetsu Kaisha, and the Mitsunari works of the same company, 60 per cent. of the output being accounted for by the last three works. It is ingenuously stated in the report that "Japanese charcoal pig-iron is inferior to the Swedish product and is even inferior to Honkeiko pig-iron."

An important fluorspar deposit, stated to be among the best in the world of this mineral, has been discovered in occupied China, according to reports from Shanghai, and is being worked in collaboration by the Japanese military authorities and the Central China Mining Company. It is stated that the exploitation of this deposit will result in far-reaching changes in the Japanese aluminium industry.

The nickel situation in Japan has always been a difficult one, as she has had to rely on foreign sources for the whole of her supplies, although taking pains to develop various of the low-grade deposits within her own territorial sphere. Efforts have, of course, also been made to find a suitable substitute for this metal, but with the usual lack of success. Recent reports state that a process has now been evolved which will enable low-grade ores to be treated economically, the sponsors of the process being the Nippon Nickel Kaisha. Since the beginning of 1938 this concern has invested over 70 million yen in the erection of plant at Onishi-machi, Gumma prefecture, where serpentine is treated. The whole of the nickel is used for armament purposes. In 1940, a merger with the Oriental Nickel Company was concluded. The process is claimed to have been such a success that foreign firms have been interested and sought licences to operate the process. Our last report stated that details of the process would be made public shortly.

The Japanese Ministry of Commerce and Industry to conserve iron and steel recently promulgated new decrees prohibiting the manufacture of 150 additional iron and steel products, mainly small items of a non-essential nature.

Wartime Salvage in Canada

The subject of "Raw Materials and Salvage" is discussed in the Monthly Letter of the Royal Bank of Canada. It is pointed out that recent events in the Pacific threaten North America, not only on the military and naval fronts, but also in the economic aspects of their war effort. From that corner of South-eastern Asia most directly involved in war with Japan comes 99 per cent. of the world's rubber—53 per cent. from British Malaya, India, Burma, and other British possessions, 39 per cent. from the Netherlands East Indies, and 7 per cent. from Indo-China and Thailand. Approximately 75 per cent. of the world's tin comes from the same area, which also possesses rich petroleum resources.

The collection of waste materials is not merely a wartime activity, but an important business at all times. In this emergency, however, it must replace, rather than supplement, ordinary sources of supply. In 1939 some 170,000 tons of reclaimed rubber, the equivalent of 85,000 tons of crude rubber, were produced in the United States, and it is estimated that their available equipment could, at full capacity, process almost double that amount. The annual volume of business done by waste metal dealers in the United States is estimated at one billion dollars, and as early as last September ways and means of increasing this by 20 per cent. were under discussion in Washington. At that time it was reported that during 1941 about 25 per cent. of all new steel produced would come from scrap; likewise scrap contributed 34 per cent. of the copper supply, 29 per cent. of the tin, 22 per cent. of the aluminium, 20 per cent. of the lead, and 16 per cent. of the rubber.

Huge Scrap Dumps

It is estimated that 2,000,000 tons of iron and steel scrap are resting in the basements, dump heaps and automobile graveyards of Canada. An intensive campaign is now under way to restore a large part of this scrap to valuable use in machinery and tools of war. The collection of iron and steel scrap is at present the principal objective of the National Salvage Committee of the Department of National War Services. But it is by no means the only objective. A nation-wide campaign for the collection of secondary materials of many kinds was in progress throughout 1941, and will continue until the end of the war. A special drive for aluminium was successfully undertaken in September, and the collection of copper, brass, lead, zinc and other non-ferrous metals is continuous. All of these metals are essential to the war effort.

When metals are scarce, and particularly now that tin supplies are dangerously threatened, the question is asked why not save the millions of tin cans that are thrown away in Canada every year? This question has been carefully studied both in Ottawa and Washington, and in each case the answer has been that it is not economical to collect tin cans, unless and until an emergency in the supply of tin renders it imperative to conserve tin without regard to its cost. At present the cost of collection and delivery to detinning plants in the United States is prohibitive, and in Canada plants would have to be built before collection would be even worth considering. Furthermore, 100 lbs. of tin cans yield only 1.2 lbs. of tin; the residual tin which cannot be removed reduces the value of the steel scrap to the lowest level. While there is apparently an inexcusable theoretical waste of tin in the destruction of tin cans, the cost of recovery is so high that it would only be feasible in the face of the gravest emergency. A drive is also in progress to collect and recover paper and cardboard, rags and fibres, oils, fats, and many other products essential to the war effort.

Canadian Mineral Output in 1940

The total value of the mineral production of Canada in 1940 is estimated by the Dominions Statistician at $529,179,000, a gain of 11.5 per cent. over 1939 and a new high record. The value of production in the metals group increased from $343,506,000 to $382,876,000. The combined value of the base metals—copper, nickel, lead and zinc—advanced from $136,277,000 to $155,840,000. A miscellaneous group consisting of arsenic, iron ore, mercury, radium, selenium, tellurium, titanium ore and uranium, increased in value from $1,809,000 to $2,449,000.

American Aluminium Notes

ALCOA'S 1941 REVIEW

Reviewing conditions in 1941, Roy A. Hunt, President, Aluminum Company of America (Alcoa), calls attention to the vast increase of aluminium production by Alcoa to a rate several times that of 1938, last full peacetime year, as well as the start of construction on more than $90,000,000 worth of Government-owned plants which Alcoa contracted during 1941 to build and, in some cases, to operate, and the reduction of Alcoa's price for aluminium ingot to 15 cents per lb., the record lowest level. Three of the new plants, with a total productive capacity exceeding what the whole nation produced in 1938, will be operated by Alcoa. Completion of all the plants, and additional plants scheduled to be built by others in the industry, will raise America's total productive capacity for aluminium to an amount exceeding what it is believed all the countries under control of the Axis powers have ever produced in a year. Bauxite-mining operations, both in Surinam and in Arkansas, have been expanded, as have facilities for the conversion of bauxite into alumina, to be reduced electrolytically into aluminium. Ten vessels have been launched for transporting bauxite. Among serious problems which have not been solved is the scarcity of available electric power in quantities and at a cost favourable to the manufacture of aluminium. Only lack of additional power limits the ability of America to produce additional aluminium economically. Integration of Alcoa's hydro-electric facilities with those of TVA has resulted in an immediate gain of enough electricity to make an additional 11,000,000 lbs. of aluminium annually, and made possible the start of construction by TVA of another great hydro-electric project which will provide power for the making of further large quantities of aluminium. Nevertheless, more power immediately would be welcome.

REYNOLDS ALUMINIUM EXPANSION

With two aluminium plants built and in operation, and construction of a third in the offing, the Reynolds Metal Company looks forward to a year of all-out production for war, said R. S. Reynolds, President, Reynolds Metals Company, Inc., in a year-end survey. The year 1941 saw the company's entry into aluminium production with a plant at Listerhill, Ala., built in two days less than six months after ground was broken. A second plant was constructed at Longview, Wash., in four months and eight days, and equipment has been ordered for three new units at the Listerhill site. Total annual output for the three plants will be 160,000,000 lbs. of virgin aluminium. Besides construction of the aluminium plants, other major projects during the year included completion of an extrusion plant at Louisville, Ky., for the fabrication of strong alloy aluminium rod, shapes, tubes and other extruded products. Other new and revamped plants at Louisville give the company greatly increased capacity for the rolling of aluminium alloy rod and sheet and for the extrusion of rod, tubes, and shapes.

ALUMINIUM IN STEEL INDUSTRY

Steel producers in the United States need about 30,000 tons of aluminium per year at the present rate of operations, chiefly to deoxidise and purify molten steel, states the American Iron and Steel Institute. No thoroughly satisfactory substitutes for aluminium in steelmaking are available in sufficient quantities. About 2,000 tons of the aluminium required must be 99 per cent. pure aluminium, while the remainder can be an alloy containing 82.5 to 90 per cent. aluminium and also small amounts of copper, zinc, silicon and magnesium.

United States Chromium Control

The United States Director of Priorities has taken over the direction of all deliveries of chromium. The manufacture and delivery of alloy iron or steel containing 4 per cent. or more chromium except on A-10 or higher preference ratings has been prohibited. Approximately 55 per cent. of America's total chromium supply in 1941 was used for alloying steel with refractory use second in volume. More than 70 per cent. of metallic chromium currently being used is for defence and essential civilian purposes. While domestic production of chromium has increased greatly since the start of the defence programme, more than 90 per cent. of chromium used is imported, largely from Africa, the Philippines and Turkey.

Reports and Dividends

(Figures in brackets refer to the previous financial year.)

Head Wrightson & Company—Interim dividend of 2½% (same).

Brett's Stamping—Interim dividend of 10%, less tax (5%, tax free).

Smith's Dock Company—Dividend of 6% on the ordinary shares (same).

Burnell & Company—Trading profit for 1941, £50,415 (£48,901); dividend of 15% (same).

Alliance Aluminium Holdings—Net profit to June 30 last, £5,429 (£4,675); forward, £31,164 (£25,734).

John Bolding & Sons—Net profit for 1941, £6,869 (£5,331); final dividend of 6% (5%) on the ordinary shares, making 10% (9%).

Bullers—Profit for the year ended July 31, 1941, £26,356; brought in, £16,773; preference dividend, £7,500; ordinary dividend of 5%; forward, £20,532.

Shanks & Company—Profit for 1941, after providing for taxation and depreciation, £38,933 (£21,105); dividend of 8% (5%) on the ordinary shares.

Warner & Company—Interim dividends of 3% and 2½%, respectively, on the preference and ordinary shares for the half-year ended December 31 last.

Weyburn Engineering—Net profit to October 31 last, after taxation, £12,464 (£20,318); final dividend on the ordinary shares of 22½% and a bonus of 5%, making 35% (same).

Brooke Tool Manufacturing Company—Trading profit for the year ended September 30, 1941, after providing for taxation, £28,566 (£36,864); dividend of 25%; forward, £25,746 (£22,180).

J. & E. Hall—Net profit for the year ended September 30 last, £72,911, before charging £27,000 for income-tax (£65,841, before charging £17,000 for taxation); ordinary dividend of 8½% (same); forward, £43,639 (£43,008).

R. A. Lister & Company—Profit for the year ended September 30 last, after making provision for depreciation, management commissions, staff bonus, taxation, war damage contribution and contingencies, £90,280 (£99,577); preference dividend, £9,675; interim dividend of 5% on the ordinary shares, £17,500; final dividend of 5% and a bonus of 6%, making 16% (same), £38,500; additional pensions reserve, £10,000; to general reserve, £15,000; forward, £70,468 (£70,863).

Science and War

The Parliamentary and Scientific Committee, formed comparatively recently as a link between science and politics, held its first annual luncheon at the Savoy Hotel, London, last week, the Earl of Dudley presiding. All scientific bodies were represented.

Lord Hankey, proposing the toast of "Science," dealt with the work of the scientific advisory committee and the engineering advisory committee, emphasising how they worked in close association. One direct result of the committee's work was that there was a constant flow of scientific information and individuals between America, the Dominions, and this country.

Sir Henry Tizard, proposing the "Parliamentary and Scientific Committee," referred to the influence of science at the present time, stating that its tactical strength was very great. The same, however, could not be said of its strategical position in relation to the war. The strategy of science applied to war could only be advanced by the ever closer collaboration between the heads of the fighting services and the scientists. A typical example of this intimate collaboration was to be found in the Royal Air Force.

Lord Dudley recalled that Lord Samuel had, time and again, insisted that scientific representatives or observers should accompany diplomatic missions overseas. That was now taking place.

Vocational Aspects of the Steel Industry

Vocational and Professional Monograph No. 26, by Ralph H. Watson, Vice-President of U.S. Steel Corporation, gives authoritative and factual information regarding qualifications for persons working in the American steel industry. Outlining scholastic training requirements, it gives a brief history of the iron and steel industry, and classifies the various production and personnel classifications in the industry. There is a list of American colleges which offer metallurgical training.

World Trade in Wartime

LEAGUE OF NATIONS ECONOMIC SURVEY

As usual, the League of Nations "World Economic Survey" contains interesting information, particularly with regard to European countries. The Survey for 1939-40 points out that with the onset of war, part of Europe was cut off from markets overseas, and earlier trade tendencies were accentuated. For countries involved in or menaced by war, imports became the central interest in trade, and exports only the means to an end. Then, as trade within Continental Europe came largely under German control, the commerce of the rest of the world focused on the United Kingdom and United States.

Broadly, world trade became divided into those two areas. So far as can be judged, trade values were maintained at a remarkably high level during the greater part of the period. From the second or third quarter of 1940, however, a severe decline occurred in the exports of most European countries, and South America was also affected. German trade, on the other hand, is reported to have increased during the last half of that year. In spite of the decline in prices of certain goods in non-European markets, the average prices of goods entering into trade increased during the early part of the war. From the middle of 1940 there was a slight decline, but the rise was resumed early in 1941. European prices appear to have risen more than elsewhere.

Taking the area outside Europe, the Survey shows that in 1938 it represented 63 per cent. of world trade—United Kingdom 14 per cent., the rest of the Empire 16 per cent., the United States 11 per cent., and other countries 22 per cent. The loss to this area of the European markets was one of the major disturbances of trade caused by the war, and the reduction in European demand explains why world market prices for numerous staple products became stationary or declined in the course of 1940. The impact of these events fell with special severity on certain countries in the Western Hemisphere and the Far East. The effect of the loss of European markets would have been much greater had it not been mitigated by heavy purchases by the United Kingdom and the United States. As European supplies became unobtainable British demand was directed to other continents, and made its influence increasingly felt.

German Domination of Europe

During the early months of the war, Germany's trade is estimated to have fallen by nearly half, but subsequent events led to an expansion, particularly in German imports from European countries. German statements that her foreign trade by the end of 1940 had reached pre-war level through the expansion of commerce with other European countries implies that, as the non-European markets were cut off, Germany's trade with the Continent rose some 70 per cent. above the 1938 level. At the Reichsbank meeting in March, 1941, it was indicated that during 1940 Germany's trade with European countries (except France and the U.K.) had increased in value by about 65 per cent. above that for 1939. Simultaneously, the total trade of other European countries declined in value by about a third, and the share of Germany in their turnover increased rapidly, largely under military pressure.

By reducing the premiums previously granted to exporters, and by other devices, Germany was able to improve her terms of trade with the occupied countries. Late in 1940 Norway and Denmark are reported to have had to pay 20 per cent. higher prices for German goods than Sweden, and Germany refused to pay more for Norwegian goods than those prevailing before the occupation. Even in trade with unoccupied countries, Germany abolished export premiums and raised the export prices of numerous goods. On the other hand, Germany had to allow higher prices on certain goods she required even from occupied countries in order that the supply should not fall off rapidly.

With the increased bargaining power of the Reich during 1940, the exchange value of the mark was raised to around 20 per cent. discount on the official level, thereby further improving Germany's terms of external trade.

The reduction in trade with areas outside Europe

(*Continued in next column.*)

Industrial Psychology

1940-41 ANNUAL REPORT

The National Institute of Industrial Psychology, which celebrates its twenty-first anniversary, has issued its annual report for the year ended September 30, 1941. Referring to industrial investigations, it is pointed out that industry is faced under war conditions with problems familiar in peacetime—firms have always had to recruit, select, train, consider methods of work, working conditions such as lighting, heating and ventilation, hours, incentives, methods of wage payment, absenteeism, employee representation, and innumerable other questions in the day-to-day industrial environment. But these familiar problems have been intensified by the urgency of war production, the shortage of skilled labour, the effects of air raids, black-out, transport difficulties, and a general restlessness due to a variety of causes.

The Institute's investigations have dealt in detail with all of these problems in their new form. In solving the question of recruitment, it has been found possible to organise shifts of half-time workers with very good results. For some firms assistance has been given in selection and allocation of staff by means of tests and improved interview procedure. During the year the Institute has also helped in the detailed training of new workers. In this work it is important (1) to insist on the choice of a suitable instructor, (2) to analyse the "information" about the job so that it can be presented clearly and effectively, and (3) to study the movements required so that good methods can be taught from the start. The Institute has helped in the organisation of training departments, and has advised on methods of assisting new workers to settle down and in reducing labour turnover in the early stages. Two very successful training courses for industrial trainers were held at the Institute's headquarters during the year.

In the closely related field of methods of work and the layout and equipment of the work place, it has also been possible to introduce improvements. Few people realise, for instance, that an alteration of a few inches in the height of a foot-pedal may save an operative some 1,200 yds. of unnecessary movement in a day. In considering methods of work, the Institute has not confined its attention solely to productive work; it has also considered methods of inspection. Surprisingly wide differences are frequently found between the standards of different inspectors and the judgments of the same inspectors on different occasions. For this reason training in inspection is just as important as in directly productive operations, for often inspectors fail to realise standards to be maintained and tolerances allowed.

Many firms under present conditions have found absenteeism and unpunctuality serious handicaps to production. In dealing with the former, the Institute has found it valuable to make arrangements for all absentees to be interviewed on their return to work, for operatives need to know that their absence and unpunctuality are felt and regarded seriously. By occasional "punctuality drives" the Institute has found it possible to reduce lateness to less than a quarter of what it was.

In order to keep a group of employees satisfied and to make full use of their constructive criticism, it is important to provide some machinery by which they can bring suggestions and complaints to the notice of the management without fear of penalisation. In this connection the Institute has organised works councils and suggestion schemes, and has carried out extensive inquiries by means of confidential interviews.

In addition to other work the Institute's investigators have given individual lectures to industrial and other organisations.

(*Continued from previous column.*)

and the changes that have taken place in trade with Germany have reversed the general balance of trade of certain Continental countries. The highly developed north-western States, invaded by Germany suffered most, but being suppliers of primary goods, the agricultural countries in the south-east were relatively favoured in their trade so long as they were able to maintain their political independence.

While the war, therefore, has disrupted international commerce and created a barrier between the Axis-dominated countries and the rest of the world, it has been instrumental in achieving an intensification of trade in the latter areas.

The Week's News in Brief

Trade Talk

OWNERS OF LAID-UP YACHTS are asked by the Ministry of Supply to sell for munition-making unwanted iron and lead ballast and surplus anchor chains.

MR. G. E. BAILEY, president of the Institution of Production Engineers, has sent a message to members urging maximum production of every kind of war equipment.

ADMITTING CHARGES of unpunctuality and absenting themselves from their work, two Clyde shipyard workers were sent to prison at the Glasgow Sheriff Court on January 30.

SHEFFIELD STEELWORKERS saw themselves as film actors at the trade show of "Hard Steel," a film sponsored by Mr. Charles Boot and originally designed as propaganda for the Sheffield steel industry.

THE MANCHESTER ASSOCIATION OF ENGINEERS will hold a meeting on Saturday, February 14, at the Engineers' Club, Albert Square, Manchester, at 2.30 p.m., when Mr. D. Y. Marshall, Dipl.Eng. (The Ingersoll-Rand Company, Limited), will present a Paper on "Pneumatic Tools."

THE HYDRO-BLAST PROCESS (sand and water method) of core removal, casting cleaning and sand reclamation, as developed by The Hydro-Blast Corporation, Chicago, U.S.A., is to be marketed in this country by Pneulec, Limited, Mafeking Road, Smethwick, Nr. Birmingham.

IN THE HOUSE OF COMMONS recently, Mr. Bevin (Minister of Labour) announced that the Essential Work (General Provisions) Order was being amended so as to provide that arrears of wages were to be paid to a worker dismissed on the ground of serious misconduct if he appealed successfully to an appeal board and the National Service officer directed the employer to re-instate him.

MR. THOMAS JOHNSTON, Secretary of State for Scotland, opened the new canteen of Smith & Wellstood, Limited, ironfounders and general engineers, of Bonnybridge, on January 30. Furnishings, machinery, cooking and washing apparatus were manufactured by the firm at Bonnybridge. The canteen will accommodate 400 workers at one time.

LORD GAINFORD spoke of the birth of Middlesbrough when he addressed members of the Cleveland Literary and Philosophical Society last Friday. In 1821, he said, the population was 46. In 10 years it had increased to 154, and the population went on increasing until, in 1941, it had risen to 140,000. The discovery of ironstone in Cleveland began the iron and steel age for the area.

ANOTHER MEETING on the subject of "Efficiency in the Use of Fuel," will be held at 3 p.m. on Monday, February 16, in the Lecture Hall of the Sheffield Public Libraries. The chair will be taken by Dr. W. H. Hatfield, F.R.S., President, Sheffield Society of Engineers and Metallurgists, and the discussion will be opened by Dr. R. J. Sarjant, Mr. H. C. Armstrong, Mr. Donald Wilson, and a representative of the Institution of Mechanical Engineers, Yorkshire Branch.

A CONFERENCE OF LOCAL AUTHORITIES and other representative Scottish bodies convened by Mr. Thomas Johnston, Secretary for State for Scotland, decided last week to set up an Industrial Council for Scotland. Mr. Johnston said that, when orders for armaments stopped, they might find themselves, as after the last war, with vast problems which were practically unknown to the London Home Counties. They must therefore do their utmost to ensure that peacetime industries did not entirely desert them.

THE MINISTER OF SUPPLY has made the Control of Timber (No. 22) Order, 1942, which came into force on February 2. The chief purpose is to make minor variations in forms in respect of timber charges necessitated by the entry into force on January 5 of the Timber (Charges) (No. 5) Order, 1942, and the centralisation of the collection of timber charges at the Timber Control, Department 111/8, Clifton Down Hotel, Bristol, 8. Existing stocks of forms should be used in making returns and the necessary minor amendments made in manuscript.

THE LONDON CHAMBER OF COMMERCE, bearing in mind the experience after the last war, recently appointed a Special Committee to consider the question of the disposal of surplus stores after the war, and to make recommendations. As a result, a report was submitted to and adopted by the Council and forwarded to the Prime Minister. Amongst other points, it emphasised that the disposal of these surplus stocks shall not, as in the past, destroy markets and postpone indefinitely the restoration of normal industrial activity, but that these stores should be used to create new markets.

AT AN EXTRAORDINARY MEETING of shareholders on January 29, the motion for the voluntary liquidation of the Partington Steel & Iron Company, Limited, was carried on a poll by a very large majority. Sir Peter Rylands (the chairman) presided, and in the course of the discussion which followed his motion that the company be placed in voluntary liquidation, with Mr. Thomas Lister as liquidator, he disclosed that the purchaser of the Lancashire Steel Corporation shares at 22s. each from the company was the Securities Management Trust. The resolution authorising the liquidator to divide the assets among the members in specie was also carried.

Obituary

MR. JOHN WALLACE, of John Wallace & Sons, Limited, agricultural implement makers, Glasgow, died on February 1.

MR. WILLIAM DOWNS NELSON, retired brass-founder, late of Cardowan, Kinroos, and Townsend Place, Kirkcaldy, died on January 23.

MR. JOHN E. A. SHAW, who was secretary and a director of John Maddock & Company, malleable ironworks, Oakengates, has died at the age of 37.

MR. JOHN ROBERT ROSCOE, founder and senior partner in the firm of J. R. Roscoe & Sons, mechanical engineers, Little Hulton, Lancs, died recently, aged 83.

MR. ALEXANDER THORNTON, chairman and managing director of Dickson & Mann, Limited, Armadale, West Lothian, died suddenly at Bathgate on February 2.

MR. PHILIP GRIMLEY, mining engineer, died in London recently in his 71st year. Mr. Grimley travelled extensively and worked for many years in Mexico and West Africa.

MR. ALBERT REANEY HEATHCOTE, chairman of A. R. Heathcote & Company, Limited, machine-knife manufacturers, Sheffield, has died at his home at Bamford, Derbyshire, in his 91st year.

MR. MICHAEL C. DUNSMORE, who has died at his home in Stirling, was chief engineer for many years of the Tharsis Sulphur & Copper Company, Limited, Glasgow. He was in his 70th year.

MR. GEORGE BIRKINSHAW, managing director of T. Inman & Company, Limited, Britannia Steelworks, Sheffield, for many years, and an active partner with the late Mr. Inman, died recently.

MR. HENRY SMITH, who died on January 29, aged 71, was a former director of Prince-Smith Stells, Limited, machinery makers and ironfounders, Keighley. He retired in 1935 after a connection with the firm lasting over 50 years. He afterwards became chairman of Drakes, Limited, gas plant makers, Halifax.

Contracts Open

Heywood, February 21—Iron castings, etc., for the 12 months ending March 31, 1943, for the Corporation. Mr. A. Middleton, borough surveyor, Municipal Buildings, Heywood, Lancs.

Shrewsbury, February 28—Furnace slag, cast-iron gulley grids and frames, tools, etc., for the year ending March 31, 1943, for the Salop County Council (Roads and Bridges Department). Mr. William H. Butler, county surveyor, County Buildings, Shrewsbury.

Warminster, February 17—Construction and maintenance of about 550 yds. of 9-in. dia. spun-iron sewer and about 1,500 yds. of 8-in. and 12-in. dia. spun-iron pumping main, etc., for the Urban Council. Lemon & Blizard, consulting engineers, 3, Glen Eyre Road, Southampton. (Fee £2 2s., returnable.)

Personal

SIR W. A. ROBINSON has been elected a director of Babcock & Wilcox, Limited.

MR. D. A. BAIRD, chief designer of Mechanizations & Aero, Limited, has joined the Tank Design and Experiments Committee of the Ministry of Supply.

MR. SAMUEL EVANS, a former general manager of Brockhouse Castings, Limited, Wolverhampton, has received a presentation on his taking up a new position in the combine.

MR. JOSEPH PASHLEY, chief of the research department of Kayser Ellison & Company, Limited, steelmakers, of Sheffield, and Mr. Archie Leigh Morrison, London manager of the firm, have been appointed to the board of directors. Mr. Harold Baron has been appointed secretary in succession to Mr. Harry Rust, who died recently after holding the position for 40 years.

THE PHOSPHOR BRONZE COMPANY, LIMITED, announces the appointment of Mr. G. T. Hyslop as joint managing director, Mr. J. L. Hardy—who was formerly joint managing director with Mr. W. Smithson—having relinquished this appointment, due to pressure on his time by Hardy, Spicer & Company, Limited, Birmingham, of which company he is managing director. Mr. J. L. Hardy now becomes vice-chairman of The Phosphor Bronze Company, Limited.

MR. W. C. DEVEREUX has been released from his position as Controller of Repair and of American and Dominion Aircraft Supplies to resume control of High Duty Alloys, Limited, and the other companies in his group. When appointed seven months ago, Mr. Devereux's task was (*a*) to create an organisation capable of handling imported American aircraft and (*b*) a similar organisation to handle the repairs of aircraft engines, both British and American. With this task completed Mr. Devereux asked to be released to devote his energies once again to production matters.

Selling Prices for Non-Ferrous Scrap

The maximum prices for non-ferrous metal scrap subject to control remain at the established levels, but in connection with steps taken recently to secure a better utilisation of scrap metals the Non-ferrous Metals Control are now quoting weekly prices for process and manufacturing scrap resulting from strip, sheet, plate and tubes which are intended to represent the current market values. The following prices are for the week ended January 31, and are issued from the Office of the Joint Controllers of Non-ferrous Metals. They are all net per ton, ex-sellers' works, suitably packed:—

Brass.—S.A.A. webbing, £48 10s.; S.A.A. defective cups and cases, £47 10s.; S.A.A. cut-offs and trimmings, £45 10s.; S.A.A. turnings (baled), £36; Q.F. webbing, £49; defective Q.F. cups and cases, £49; Q.F. cut-offs, £47 10s.; Q.F. turnings, £38; other "70/30" process and manufacturing scrap, £46 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. copper, £43 10s.; process and manufacturing scrap containing 58 per cent. and up to 62 per cent. copper, £38 10s.; 85/15 gilding metal webbing, £52 10s.; 85/15 gilding defective cups and envelopes before filling, £50 10s.; cap metal webbing, £54 10s.; 90/10 gilding webbing, £53 10s.; 90/10 gilding defective cups and envelopes before filling, £51 10s.

Cupro Nickel.—80/20 cupro nickel webbing, £75 10s.; 80/20 cupro nickel defective cups and envelopes before filling, £70 10s.

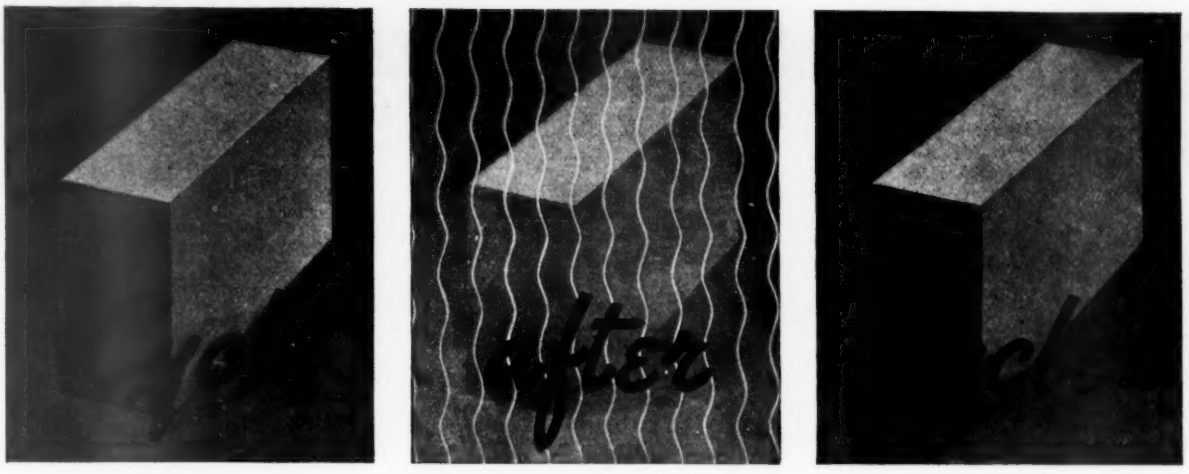
Nickel Silver.—Process and manufacturing scrap: 10 per cent. nickel, £50; 15 per cent. nickel, £56; 18 per cent. nickel, £60; 20 per cent. nickel, £63.

Copper.—Sheet cuttings and webbing untinned, £54; shell band plate scrap, £56 10s.; copper turnings (including shell band turnings), £44.

MR. C. E. LLOYD, M.P., has been elected a director of F. H. Lloyd & Company, Limited, steelfounders, of Wednesbury.

MR. WILLIAM HAMILTON, for many years chief engineer at the Dalzell Steelworks of Colvilles, Limited, has retired.

MR. A. V. REIS has resigned from the Timber Control, Ministry of Supply, and joined the mining staff of the Fife Coal Company, Limited, Cowdenbeath, Fife.



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G.P.13

FIREBRICKS: *Glenboig Special, Glenboig Special Crown, Glenboig, Glenboig Crown, Castlecary, Dykehead, Gem, White Carr, Stour, Hycone, Alumantine, Hysilyn, Adamantine, Llangennech.*
BASIC BRICKS: *Spinella, Saxpyre, Supermag, Diazite, Dolomax.*
ACID-PROOF REFRACTORIES: *Obsidianite, Losol.*

INSULATION: *Amberlite* Bricks, Cement and Concrete.
SILICA BRICKS: *Lowood, Meltham, Allen, Quartex.*
CEMENTS: *Sintex, Durax, Pyrolyte.* PLASTICS: *Durax, Rotaline, Plastic K-N., Glendoline, Ground Ganister, Steel Moulders' Compositions.* SILLIMANITE: *Tank Blocks, Bricks and Cements.* SANDS: *Moulding, Brick Facing, Silica, Glass*

Raw Material Markets

Foundrymen on Government lists are being supplied with sufficient work to maintain their plants in continuous operation. This applies chiefly to heavy foundries, as the light-foundry section has received little war work, while its normal outlets have diminished considerably. It seems improbable that Government departments will find much opportunity of placing additional business with the light foundries, while the primary need is for products for the war effort, so that the outlook for this trade is very unpromising, in view of the restrictions on ordinary domestic business and on exports. Consumers of pig-iron are rarely able to lay down stocks, as current releases generally cover only immediate requirements, although as far as high-phosphorus iron is concerned, it is possible to buy in excess of early needs.

Pig-Iron

MIDDLESBROUGH—Local ironmakers are working to satisfy the heavy demands of the steelworks, and in order to accomplish this production of Cleveland foundry iron has been suspended. Consumers are not seriously inconvenienced, however, as high-phosphorus iron is easily obtained from the Midlands at the same prices charged for iron made on the North-East Coast. Consumption of this type of iron in the light-foundry trade is not impressive, many of the works being in urgent need of new business, but a moderate tonnage is being diverted to heavy engineering works, which experience difficulty in procuring hematite, while supplies of other descriptions used by these concerns are not so free as they might be. Steelworks are absorbing appreciable tonnages of basic iron, which is coming forward satisfactorily.

LANCASHIRE—Activity at many general ironfoundries in this district is not particularly brisk, with the result that demand for Staffordshire and Derbyshire ordinary foundry irons is only moderate. Specialist engineers, on the other hand, are fully engaged on important contracts, and there is a steady flow of replacement orders coming to hand. Special refined grades of iron are moving away steadily, as the shortage of hematite makes the use of alternative descriptions imperative. Scottish pig-iron is also in good demand, and the present tendency is for demand to outstrip the supply.

MIDLANDS—Stocks of high-phosphorus iron at both the producing and receiving ends are quite extensive, as demand is not up to average levels. This is because of the short-time working in the light-castings industry, which is badly in need of fresh orders. Operations in the heavy engineering trade are at capacity levels, as the demand from the Government for its products is insatiable. The hematite supply position has necessitated changes in the mixtures of these works, and large quantities of refined iron and steel scrap are being incorporated with medium- and low-phosphorus grades. Ironfoundries are using more and more steel scrap, and the current supply might be more satisfactory than it has been of late.

SCOTLAND—There is little, if any, improvement to note in the volume of foundry and refined iron forthcoming, and deliveries are still subject to some delay. Consumers are getting sufficient to tide over their early needs, however, which is satisfactory, as users are engaged on vital work for various departments of the Government. Quiet conditions generally prevail in the light-castings trade of Falkirk and district, and the amount of essential business shared out is restricted, many works being incapable of coping with the special requirements of the war machine. Adequate supplies of high-phosphorus iron are being despatched from the English Midlands.

Coke

The foundry coke position has possibly been more satisfactory this winter than in previous war years, as good reserves have been built up at the consuming plants. The reward of this foresight is now being reaped, as deliveries from the ovens during the past few weeks have been somewhat erratic.

Scrap

There are indications that the collection of ferrous scrap is being pursued with gratifying vigour, although there is no occasion for any relaxation of efforts, as needs tend to become steadily greater. It is now no longer possible to import cargoes of foreign scrap without first paying due regard to the shortage of shipping tonnage and the other factors involved in the import trade at this juncture. It has been definitely laid down that we cannot afford to allocate ships for the purpose of bringing scrap to these shores, so that it is imperative to put to good use every ounce of metal which can be located at home.

Steel

Demand for structural steel continues to expand, and many producers' order-books are beginning to look quite healthy, although there is still need for further orders. Sheet mills are well placed, while the demand for plates is, of course, at a very substantial level, with every prospect of active conditions ruling for a long time to come. New plant for the manufacture of special alloy steel is frequently being brought into commission, and output is being correspondingly increased.

Metals

COPPER—Many and varied are the demands on copper in the United Kingdom, but deliveries to essential consumers are eminently satisfactory. It is not possible, of course, to compare the present supply position with the past, as it would be folly for the authorities to reveal to the world at large details of our resources in copper, or in any other raw material of such value to the war effort, but the fact that there appears to have been no apparent curtailment of deliveries to other than non-essential users suggests that the situation either now or in prospect is not unfavourable. The Americans are still busy on plans to step up output of copper and to reduce consumption among buyers whose work is not closely associated with war production. Commercial undertakings in the United States may no longer enter into fresh contracts with foreign sellers of copper ore unless the permission of the Office of Production Management is granted, an Order which has been unfavourably received and which may have to be amended, as the industry believes that the regulation will have the effect of causing delays.

TIN—The prolonged delay in the fixation of official buying and selling prices for tin is the subject of adverse criticism among traders. While a big proportion of the consumption in this country is necessary for the prosecution of the war, there is still a certain amount of non-essential usage of the metal which will have to be promptly eliminated in view of the new situation in the supply position engendered by Japan's acts of aggression.

In the House of Commons last week Col. Burton asked the Secretary for Mines whether he was prepared to recommend financial or other assistance to the tin-mining industry in Great Britain, and what was the number of mines closed down owing to the inability to extract ore on an economic basis. Mr. Harold Macmillan, who replied, said the Secretary for Mines had asked the newly appointed Controller of Non-Ferrous Mineral Development to investigate and report on mining in Cornwall as a matter of urgency, and the question of assistance would be considered in the light of that report. He was informed that three tin mines with a small output had been closed since the outbreak of war, but he could not say that this was entirely due to economic difficulties. The investigation into the Cornish tin industry by Sir William Larke, the Controller of Non-Ferrous Mineral Development, will have to cover many aspects, including labour, which may well present some difficulty, finance, and potential production.

SPELTER—Economy in the use of zinc has been officially encouraged and, indeed, enforced for some time past, but, in the light of recent events in the Far East, it is obvious that restrictions must now be applied much more rigorously. The needs of brassmakers and die-casters and other working-up industries tied up with Government orders must be watched very closely and, although the current supply of spelter may be quite sufficient to cover important requirements, the claims by less essential consumers cannot go through without stringent scrutiny. Allocations of zinc in the galvanising industry will have to be reduced, despite the fact that this trade uses g.o.b., whereas brassmaking, etc., calls for high-grade metal.

LEAD—This metal has become in increased demand for war production of late, necessitating a reduction in consumption in other directions. According to the American Bureau of Metal Statistics, production of lead in the U.S.A. in December last totalled 57,200 short tons, against 48,900 tons in the previous month, and it is to be hoped that output in January made further progress. In January, 1941, it is of interest to note, output reached the impressive figure of 62,048 tons, but after May of last year production fell away. Further advices from America state that the Metals Reserve Company has renewed its contracts with lead producers in Mexico, Peru and Canada for periods of two or three months. The tonnages involved are not given, but the price paid is believed to be 4 cents per lb., against 3.75 cents, f.o.b.

SCRAP—Maximum prices for non-ferrous scrap are unchanged. The scrap Order makes it possible for manufacturers to negotiate deals with their customers and prices of process material are now published weekly, these figures covering "domestic" transactions. They are of particular benefit in cases where manufacturer and buyer fail to come to agreement. Prices of scrap on the open market change but little, if at all, from week to week.

CAST-STEEL HULLS are now being made in considerable quantities in the United States for the medium tank. This type of hull is being used increasingly; a minimum of 30 per cent. of future production will have the cast hull and the balance will be of welded construction, states an official War Department announcement.

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